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THE USEFULNESS OF CHEMISTRY IN THE INDUSTRIES[1]

ONE month ago I had the pleasure of addressing the University of Illinois section on the subject, "Chemistry and Industry." On that occasion I departed somewhat from the orthodox position of loyal chemists, which is that manufacturing industry could not long survive in the absence of chemists and a science of chemistry, and that manufacturing industry owes a large debt of gratitude, if not of worldly goods, to the chemical profession; and I endeavored to show how, long before a science of chemistry developed, a sufficient amount of chemical knowledge and a sufficient number of chemical facts were accumulated by the earliest civilizations of which we have a record, to enable them to establish and conduct chemical manufactures in a rather creditable manner. I felt it was necessary to emphasize this fact, which is frequently lost sight of in the pursuit of laboratory chemistry, in the interest of a fair understanding of the relationship between the science of chemistry, and manufacture, and in the interest of fair play, too, because I should not care to give chemistry more than its due.

There are, broadly considered, but two kinds of manufacture; one of them is concerned with those processes which change the form of matter only, mechanical manufacture, and includes such industries as the founding, metal-working, wood-working

[1] Address delivered before the Indianapolis Section of the American Chemical Society, March 20, 1908.

and weaving industries; the other is concerned with those processes in which the composition of matter is changed, chemical manufacture, and includes metallurgy, clay burning, glass making and the heavy chemical industries. By far the greatest number of industries partake of the nature of both these branches—in other words, are both mechanical and chemical—and in this way chemistry has a greater or less importance in connection with all industries. Students of the development of the human race find that the mechanical arts develop first; but not long afterwards and long before recorded history, are found evidences of a knowledge of metallurgy and of ceramics in the remains of iron and bronze implements and of earthenware utensils. Metallurgy and ceramics are both chemical industries, and they both presume a knowledge of chemical facts, that is, they presume a knowledge of the properties of certain substances, the ores in one case, clay in the other, and of the changes in composition which those substances undergo. If we turn to ancient Egypt, which is unique in having developed a somewhat advanced civilization in an early period and in having preserved by monument, picture, scroll and ornament a record of that civilization, we find that the people of that country, in addition to a knowledge of metallurgy and ceramics, were also informed in the arts of dyeing, pigment manufacture, varnish making, plaster making, paper making and the fermentation industries—all chemical manufacture—and most interesting of all, they were well versed in that distinctly chemical and not altogether simple industry—glass manufacture. Five thousand years ago they made a glass which approximates closely in composition the common glass, so-called soda-lime glass, of to-day. Now glass making is interesting from a number of standpoints. It did not develop as many other chemical industries did, apparently, in a number of localities widely separated, but in one, and that Egypt, and thence it spread throughout the world. So it is comparatively easy to trace the spread and the growth and the historical development of glass-making. On the east the Babylonians, the Assyrians, the Chaldeans, the Phœnicians learned the art; on the north the Greeks and Romans; China probably learned the art from Egypt by way of Ceylon, to which place adventurous merchants journeyed; India learned it later; Byzantium learned the art from Rome, and through Rome, too, the knowledge filtered and spread into Italy, beyond the Alps, and into the Rhine country. In the seventh century the Arabians, in their rise as a conquering nation, overran Egypt, learned her arts and carried the glass industry into Spain, where it flourished. Finally the industry centered in Bohemia, which is preeminent in this industry to-day. And thus the history of glass making can be traced from the most ancient times down to the beginning of modern history. Nor is this all, for in tracing the history of one chemical manufacture, one inevitably comes in contact with others. An industrial people is seldom satisfied with one industry and so where glass making flourished, as a rule other industries flourished also. Nobody knows how glass making was first discovered. Ordinary glass is composed of silica, lime and soda and can be made by melting together sand, limestone and soda in the proper proportions and at a sufficiently high temperature. The Nile valley is cut through limestone rock and this is the common building stone of the region. Soda occurs there, as it does in the arid regions of this country, as an incrustation on the surface of the soil—*alkali,* to use the common expression; and sand is, of course, abundant. It would be hard to

find a place better supplied with the raw materials of glass making, and possibly this will account in some degree for the development of the industry there. But not entirely. And so we have various explanations of its origin. The ancient Egyptians were skilled metallurgists and smelted copper, iron, lead and tin and also refined the noble metals. One hypothesis says that the Egyptians first became acquainted with glass owing to the accidental similarity of the slag from one of their furnaces with that product. Another states that the burning of piles of straw frequently results in the production of glass because the potash in the ash combines with the sand and lime of the ash or of the soil beneath, in the heat of the conflagration. And you are all probably familiar with the old story accrediting the discovery to the Phœnicians, those bold seamen and traders of ancient times. This story, which is told by Pliny, that old Roman, than whom I suppose no man ever recorded more truth and untruth, relates how a certain Phœnician ship laden with soda was moored off a sandy shore, and how the merchants came ashore from the ship to cook their evening meal. There were no stones at hand on which to rest their pots and so they brought ashore some lumps of soda from their ship. As their fire grew hotter, the soda and sand fused and they were surprised to behold transparent streams (molten glass) flowing forth and consisting of a liquid previously unknown. The tale is interesting, for any tale is true as long as the telling lasts, but we know that the Phœnicians learned the art of glass making from the Egyptians.

But in whatever manner the ancient peoples learned the art of making glass and other chemical arts, it is certain that as one age succeeded another, the information spread and was handed down from father to son, from generation to generation. The arts were improved and a considerable store of chemical facts were acquired, in a practical way, concerning practical chemical processes. And I endeavored to show, besides the fact that chemical industries were established so long before the science of chemistry, the further fact that the science of chemistry owes a great debt of gratitude to manufacturing industry. In this way: If the chemical knowledge of the ancients could have been transmitted to the middle ages and the modern world only by books, we would know little or nothing of the facts which they slowly and laboriously acquired. Ancient records and books are extremely few in number, and worse than that, the scientific writings, when they are not purely speculative, are quite unreliable. The Greek and Roman poets recorded quite as many facts as did the philosophers and prose writers, and strange to say, the student of ancient knowledge refers as frequently to the ancient poets as to others. I repeat then, that if the world had been dependent upon written books for the transmission of chemical knowledge for, say, from 5000 B.C. to A.D. 1200, it would have fared poorly. There were two methods by which that knowledge was transmitted. The first, the alchemistic writings of the Egyptians and the Arabians; and second, the traditional knowledge of the chemical industries. The laboratory chemistry of the period I have mentioned was, in the early part of it, somewhat alchemistic in its tendency and in the latter part avowedly and emphatically so. Now all alchemistic records must be taken with plenty of seasoning, and are rather poor and unnutritious chemical food at that. And so I say that the principal means by which the chemical knowledge of the ancients was transmitted to the modern world was by means of the

traditional method, from the elder to the younger generation working in the chemical industries. So for the old chemical industries we chemists should be thankful.

But some of you may ask: What of the great philosophers of Greece—what did they do for chemistry—Empedocles, Democritus, Aristotle and the rest? There is nothing like going to original sources for information and correct impressions, and therefore in answer I shall ask you to read from one of these philosophers—Empedocles. You all remember what sort of a man Empedocles is reputed to have been. He lived in Agrigentum in the island of Sicily to the south of Italy from 490 to 430 B.C. He was at once statesman, prophet, poet, physicist, physician and reformer. The few remains of his numerous writings are in verse—the classic hexameter. Imagine Sir Wm. Ramsay chronicling the discovery of argon in hexameters! Empedocles came of a proud family, was austere, august, studious, silent, and when he walked abroad in his purple robes bound by a golden girdle, a garland bound around his long hair, with brazen sandals on his feet and his retinue of slaves behind—for Greece and the Grecian colonies were slave-holding countries—he excited the wonder and the admiration of the populace. If you will read Empedocles you will see that he considered that all things are composed of four "elements" so called, earth, water, air and fire, and that the two forces, love and strife, or as we should say, I suppose, attractive and repulsive force, by acting upon these elements, caused changes in the composition of matter.

Another philosopher, Democritus, who lived about 490–390 B.C., in Abdera, in Thrace, made another guess at the secret of chemical composition. His hypothesis concerning the composition of matter considered that there were in all the universe but two entities—vacuum and atoms. Vacuum represented void, interplanetary space. All material things were composed of atoms. All spirit, too, was composed of atoms as well. They were invisible particles, extended, heavy, impenetrable, of various shapes, uncaused, eternally-existent and in ceaseless motion. This hypothesis bears a striking resemblance to the atomic theory of to-day. You see men, like children, have in all ages asked the questions: "What is this made of? What is that made of?" and have endeavored to answer these questions.

You will have guessed already the difficulty with the chemistry of the Greeks. It amounted to nothing more than speculation. The hypotheses were never tested in the workshop of science—the laboratory; they remained at the last what they were in the beginning—unproven products of the imagination. And I think I may safely say that all the Grecian philosophy, as a means of developing and preserving chemical knowledge, was worth less than one factory engaged in chemical manufacture—let us say a factory engaged in the manufacture of glass.

So, on the last occasion on which I spoke of "Chemistry and Industry" I emphasized, and indeed over-emphasized for the sake of the argument, the debt of gratitude owed by the science of chemistry to the manufacturing industries. To-night I wish to take the other view-point and show what the science of chemistry has done and can yet do for manufacture. In truth, manufacture and chemistry must be considered as close partners in the affairs of to-day and neither could well be deprived of the other.

In ancient times and during the middle ages progress in both manufacture and chemistry was slow. That progress goes on in an ever-increasing ratio, and very suggestive of the great progress that has

been made is the fact that accuracy, and certainty in application, have increased to as great an extent as rapidity of discovery.

I would like to think of chemistry as an essentially practical science—one which can be directly applied to supplying the wants of mankind. Let us not forget, in our admiration of the brilliant researches of an Ostwald, a Van't Hoff, or a Ramsay, that in the judgment of time even the greatest and most brilliant feats of the mind must be accorded a mediocre place if they are not ultimately practical.

As I have said, there are two classes of manufacture—the mechanical and the chemical. This means that two classes of men have been mainly instrumental in developing manufacture—the mechanical engineer and the chemist. I should not give either class preeminence in industry. I should not say that either one was more necessary to the proper conduct of a manufacturing business than the other; *both* are essential to the highest development of industry. Once in a long time it happens that a man is born with a sufficiently broad conception of science and art, with sufficient industry, and with a sufficiently tireless mind and body that he can pursue both callings. Need I say that such a man is unusual, that he is possessed of unusual talents? Indeed, I might say, if the term genius were ordinarily applied to those who devote their lives not to the fine arts and literature, but to the more lowly calling of fashioning material things with their hands, that he is a genius. Ordinarily we must be content to have the chemical engineer embodied in two individuals—one of them an engineer and the other a chemist, and these men by cooperation and by combination of their separate talents, must develop the manufacture of the future. I can not refrain at this juncture from indulging in just a word of caution to those institutions of learning which offer the degree C.E.—chemical engineer—at the end of a four years' course, possibly with the proviso of one or two years' successful work, after leaving school, in some industrial laboratory. Let me say that a degree in itself means nothing, and the degree of chemical engineer should by all means be a post-graduate degree equivalent to the doctor's degree and should be reserved for exceptional, and not given to ordinary, students. A degree in itself means nothing and may be no more appropriate to the individual than the degree given by some sophomores to the boastful freshman. They painted the letters on his back—A.S.S., which they said stood for astonishing smart scholar.

Let us understand clearly that progress in the manufacturing industries which make use of chemical processes will be uncertain and slow, or altogether impossible, without a well-developed chemical science to furnish new ideas. Let us remember that chemical manufacture has developed more in the period from 1850 to the present time than in all the previous centuries and millenniums of mankind's earth. And while we may well be astonished at the chemical industries which developed when there was no science of chemistry, they were as nothing compared with the chemical industries which have been and are developing in our own time.

To come down to details: As I see it, the chemist may be useful in the manufacturing industries in four different ways:

1. In the buying and selling of materials according to analysis.

2. In the chemical control of manufacturing operations by analyzing raw, intermediate and final products.

3. In a consulting capacity, interpreting chemical process, terms, and operations to the administrative heads of the business.

4. In the improvement of plant and processes, including the working up of by-

products, cheapening of operations, and turning low-grade products into high-grade ones.

I shall take up these four different lines of work, one after another, somewhat in detail.

First—The buying and selling of materials according to analysis. I take it for granted that no modern manufacturing plant can run without power—power is indeed the chief distinguishing characteristic of modern plants as contrasted with ancient ones—and the principal source of power still is steam under pressure, and the heat necessary to generate steam is derived from burning coal. In very recent months plants have been constructed which derive their power from gas engines operating on producer gas, blast furnace gas, etc., and such plants may operate entirely without steam power. The demands made upon the world's coal supply for power have increased greatly in recent years; the coal supply can not last forever; and so, means must be devised for making the coal supply last longer either by utilizing more of the energy or by working out methods for substituting other sources of energy for heat energy. The gas engine is the result of efforts in the first direction and the conversion of the gravitational energy of falling water into electrical energy is the result of the second. In spite of the efforts now being made to conserve the coal supply, the heat from burning coal applied to steam boilers is still the universal way of producing power. To operate a boiler plant a good water supply is necessary. There must not be too large a quantity of incrusting substances in the water, or scale will form in the boiler; the water must not be too alkaline, or it will prime or foam in the boiler. If only a poor water supply is to be had, then the chemist must provide a purification plant or boiler compound which will prevent or minimize the formation of scale. The coal received at all large plants is regularly analyzed and by many the coal is contracted for and bought on analysis. Thus for the very fundamental process of generating power for operating purposes, the manufacturing plant must call in the services of the chemist.

But every plant buys large quantities of supplies besides coal and water. For construction work there is Portland cement, which must be analyzed and tested; and lime and sand are frequently examined by the chemist. The railroad buys its iron and steel, bronze and babbitt, brass and tin according to analysis; the packing-house buys its salt, sugar and vinegar in this way; the soap factory buys oils and tallows, caustic soda and soda ash, essential oils and artificial perfumes entirely according to composition and purity; the sulphuric-acid plant buys its pyrites; the fertilizer plant its potash salts; the glass factory its sand, its lime, its soda; the explosive factory its glycerine and nitric acid, all according to the chemist's certificate. The analytical chemist has come to be a factor of enormous importance in the affairs of the commercial world. The very standard of the basis of exchange is determined by his assay; he analyzes every product from stone and iron to food and spices.

Of course, the thought will occur to you: How was manufacture and exchange conducted at all in the days before chemistry and chemists became so important? How did manufacturers and business men get along at all? Well, they got along fairly well then, but to-day I am afraid their difficulties would be many. The keen competition of to-day and the more elaborate working up of by-products, yes the greater complexity of modern society, have brought about the change. Still, even to-day there are plants of fair size which

are operating without chemists. I know of a soap factory, for example, in which the fats are bought on inspection, the alkalies on the seller's analysis, and no control whatever is exercised over the chemical process of soap-making excepting that afforded by the sense of taste which is used in determining when the boiling soap is approximately neutral. The soap lyes are not refined, but are shipped in drums to the refiner.

Somebody may ask: How can a small plant afford to employ a chemist and so increase its pay-roll by a greater or less sum? My reply is that it is not necessary for the small plant to employ a chemist on the spot. At all the large commercial and industrial centers will be found commercial chemists who will make yearly contracts on the basis of the output, to handle all analyses and serve in a consulting capacity as well, in the interest of the plant. I have in mind one such laboratory in Chicago, which serves in an analytical capacity for about four hundred small and large foundries at a moderate compensation for each one. Each day the foundries send in their samples and these are analyzed at night; in the morning the various foundries are notified by telegram or letter as to whether their mixtures are right or wrong, and if wrong they are told how to correct them.

The second way in which I have said the chemist is useful in the modern factory is in following what we call the chemical control work of the factory. In brief, this means the analysis of the raw material, of the intermediate products and of the final products of manufacture. In blast furnace practise, the control work would include the analysis of the ore, of the coke, and of the limestone which go to make up the charge, of the pig iron produced in the operation, and possibly of the slag for cement-making purposes and of the blast-furnace gases. This is an old story to chemists and to those who are familiar with the chemical profession, but I would like to emphasize the fact, that this technical analysis or control work is, so far as the operative side of an industry is concerned, the vital and important thing. There is no doubt that analysis is the backbone of chemistry, and it is well to remember that analytical methods can not be made too exact. The business and commercial and manufacturing world to-day is scrutinizing intently the work of the analytical chemists, both in works and in commercial laboratories, and day by day is demanding more exact and carefully made analyses. I can see signs at the present time of demands in point of accuracy of analytical work which will tax to the utmost the resources of chemical invention. The question of accuracy and rapidity in technical analysis is a most important one and in the near future our great chemical society, through its division of industrial chemists and chemical engineers, must take up this question and by means of committees and cooperative work give the manufacturing world what it is demanding.

There is no factory engaged in the transformation of substances chemically which does not require this control work by chemists. In a soap factory, the raw fats and the alkalies are analyzed; during the process the product is examined for completeness of saponification; the lyes are analyzed for their glycerine content and for excess caustic soda and sodium carbonate; the crude glycerine must be analyzed and the chemically pure and dynamite glycerine after distillation. Finally the finished product must be analyzed from time to time, and the soap of other makers as well, for the sake of comparison.

The Portland cement industry has grown to enormous proportions in this country in recent years and in that industry, again,

the turning out of strong and sound cement is a matter depending almost wholly upon the carefulness of the control exercised by the chemist. The limestone or marl and the clay or blast-furnace slag which go to make up the mix, must be analyzed with the greatest care, to insure a uniform product of high quality. I have mentioned the word "uniform." Probably no single thing in manufacture is more important than the turning out of a product which is of the same quality from day to day and from year to year. The public even to-day buys largely according to appearances, and, for example, if one lot of commercial fertilizer is gray and another brown, although of the same grade and composition, the farmer is very apt to have a strong prejudice in favor of one or the other.

The list of industries in which the chemical control work is vitally important might be extended indefinitely. I will only say that in every well-organized pottery works in the country, in every large brewery, in every oil works, gas works, wood distillation plant, varnish works, sugar factory, explosive plant, dye house, tannery, glue factory and fertilizer plant, not to mention those very modern lines of industry which are engaged in the manufacture of acids, alkalies and salts—the so-called heavy chemicals—there is a well-organized laboratory and chemical staff constantly engaged in this work of chemical control. It is hardly necessary, under these circumstances, to answer the question: Does it pay? if the question should be asked. I say unqualifiedly that not only does it pay, but it nets the industry the largest return on the investment of any branch of the establishment. I will go further and say that during the next ten or twenty years, where there is one chemist working at a given industry now, there will be two or three chemists working then. And that this great increase in the chemical forces of this country will mean more to the development of the manufacturing industries here than mere words can express. Germany's preeminence in certain large lines of manufacture to-day is freely acknowledged to be due solely to the contributions which her scientific men, and chiefly her chemists, have made to the cause of manufacture.

The third way in which I stated that the chemist is useful in the manufacturing plant was in the capacity of consulting man, interpreting chemical processes, terms and operations to the administrative heads of the business. In a large plant there is constantly coming up a host of new problems and suggested processes, as well as incidental questions, which can only be properly handled by a technical chemist. To him comes the manager, the president, the superintendent or other members of the executive staff, asking for information: And on these occasions, the chemist is the man of ready reference for everybody. When the questions are coming in thick and fast, his information must be practically all that is recorded in existing and non-existing scientific books and journals and his mind must be as well organized as a card index in a library. There is no question concerning force or matter on this earth, the heavens above or the waters beneath, that the manager or superintendent can not ask, or, I am happy to say, his chemist can not answer with equal facility. What is the difference between salt and sugar? If an iron pipe will rust, why will not a lead pipe? Have you got a good recipe for taking aniline stains out of a table cloth? What is the latest decision on the Board of Food and Drug Inspection? How much salt per day is the proper ration for draft horses? And the list might be carried on to infinity. All these questions, I say, the chemist can

answer with as great facility as the layman can ask them.

The fourth sphere of usefulness which I suggested referred to the improvement of plant and processes, including the working up of by-products and cheapening of operations, and turning low-grade products into high-grade ones. Work of this nature is to be viewed in a different light from the other kinds of work which I have described. I should say that while all plants require analytical and control work and also consulting work, there are many plants which can operate, and operate successfully, without any of the research work implied in the present category. This fact is not to be taken as a criticism against the plant, but is to be accepted as a natural feature of industrial operations. Not all plants can lead. There must always be a considerable number which work along the accepted lines of their particular branch with no great desire to take the initiative in developing plant and process. The man who can invent, describe, work out in detail, instal and operate a new industrial process or an improvement on an old one, is an extremely rare person. He must have inventive ability, profound knowledge, keen insight, imagination, initiative, tireless energy and that wonderful faculty of elimination of the non-essential. One of the great mistakes of the present tendency in chemical education is, in my opinion, that every young student of chemistry is taught to believe, or at least is not taught to disbelieve, that on a modest or even a considerable foundation of chemical information he can become a research man in an industrial laboratory and an improver of processes in manufacture. This is a serious mistake. No amount of chemical training can change the nature or the talents of a man, and yet almost every young man who enters an industrial laboratory seems to have the idea that any work but research, or work of an executive nature, is not to be considered worthy. The simple result of this is that the men are failures as research or executive men if given an opportunity, and, further, because they do not regard as sufficiently important for their consideration that foundation of our science, analytical chemistry, they are bad analysts. It is an astonishing thing that the great rarity in an industrial laboratory is a first-class analyst. Most men, instead of looking upon skill in analysis as a desirable thing to attain, consider it as of secondary importance. To them, apparently, the work of Berzelius, of Stas, of Fresenius and of Hillebrand does not appeal, or does not influence them greatly. I believe that every chemist, no matter what line he may be working along, whether a teacher in a high school, a university professor, a consulting chemist or a chemical engineer, should be first of all a capable analyst.

These remarks are somewhat aside from the immediate topic. The chemical engineer—for by this much-abused name I prefer to call those chemists who are able to improve plant and process—has a high calling. Fortunate indeed is the establishment which possesses such a man. In my own limited experience, not more than one chemist in one hundred (and possibly the ratio is lower yet) is entitled to be called by that name. And the greatest of these, the Bessemers, the Solvays, the LeBlancs, the Chances, the Lunges, the Knietsches, stand out as notable landmarks in the course of the history of chemistry. Notice, I have given the names of the men who have *successfully* worked upon new processes. To indicate the difference implied in this statement between the unsuccessful and the successful workers, I shall say that in 1837 Gossage proposed reactions for the recovery of tank waste in the LeBlanc soda process. He worked on the process

from 1837 until 1847; nor was he, like many inventors, without funds to carry on his work. He spent a considerable fortune in carrying on his researches, but failed. It was not until 1888 that the Chance-Claus process, simple and cheap, based upon Gossage's reactions, was successfully introduced. There are other examples identical with this one. The reactions in the Solvay process, the Hargreaves-Robinson process, the Deacon process, the contact sulphuric-acid process, were all known before the men were found who could successfully introduce them into manufacture.

I have now dealt at some length with the usefulness of chemistry in the manufacturing industries, but there are other applications of chemistry which I must mention or I shall not have presented my subject to you in the fullest extent. The science of chemistry has permeated every field and phase of modern life. Its growth has been so steady and so silent, and it has been developed on the whole by so few men and in the retirement of laboratories and studies, that the public mind has hardly yet awakened to its full significance. As to its possibilities, no men, not even its enthusiastic disciples and devotees, dare to predict. They only watch its growth and foster it as they would a child. I wonder how long it will take us to catch up with our own times. We live, it seems, half in the past and half in the future. We look back to our boyhood days with delight, and think, to mention only one example, of the good things we used to have to eat, and we look ahead to some future time when those conditions shall have been restored. How often do we seriously stop to consider that engineering and chemical science have made and are making possible better ways of living than were ever possible before? I wonder how long it will take us to realize that better butter can be and is being made in creameries than on the farm, that better hams and bacon can be and are being made in modern packing-houses than in the country butcher shop, that better bread can be and is being made in bakeries than in the home—not to mention the superiority of that distinctly modern invention—the breakfast cereal? Why should it not be true that the larger establishments are able to turn out better and more uniform goods than the smaller ones? In the large institutions formulas can be worked out scientifically by the experts employed there, whereas in the small institutions where the services of the expert are not afforded, that relic of a dark and barbarous age—the so-called rule-of-thumb—still holds sway. In all these developments, modern chemistry has taken a preeminent part. There is no home in this broad land of ours, no home in the whole civilized world, but is better ventilated, better heated, better lighted and supplied with better food and clothing, owing to the applications of the science of chemistry. A broad statement, you will say. Possibly. Take the question of lighting. Glass is a very old invention, but window glass is a modern one—for example; in Roman times, from the beginning of our era to the downfall of the empire, glass was extensively used for tableware (more extensively than it is to-day, in the better Roman families), it was used for ornaments, for mural mosaic work, for pavements in courts, but not for windows. Window glass is a modern invention. And I ask you, how would you like to substitute for the broad clear panes in your dwellings the translucent sea shells, the mica, the oiled paper and the other devices which have been used at various times and by various peoples to let in the light of the sun and shut out the cold of winter? But window glass has to do with natural

light—what has chemistry done to improve artificial illumination? In ancient times animal and vegetable oils and fats, waxes and resins, were used for illumination in lamps, candles and torches. The flames must have been extremely smoky, odorous and generally disagreeable. It was in the early eighteen hundreds that the stearic-acid candle was introduced, following Chevreul's pioneer work on the chemistry of the animal and vegetable oils and fats. It was later still when crude petroleum was refined by the chemist and kerosene and gasoline came into general use for lighting and heating. Coal gas, the discovery of Clayton in 1675, was first used for illumination in modern times by Wm. Murdoch in 1792, who lighted his own house with it. Now illuminating gas of one kind or another issues from orifices in the earth in various places and the Chinese at an early day made use of this gas for evaporating salt brine and for lighting salt factories. But no general use was made of either natural or artificial gas until the early eighteen hundreds. In the United States at the present time more than $200,000,000 is invested in gas plants, and the gas industry is, of course, a chemical industry developed by chemists. But with gas flames as with other flames, more of the energy is dissipated as heat than is radiated as light, and for many years the problem of obtaining a larger percentage of the energy of combustibles in the form of light was an unsolved problem. It was known that certain oxides, such as those of calcium and magnesium, emitted a brilliant light when heated, but these oxides were brittle and a mantle made of them would crumble and fall apart. But with the discovery of new elements and the investigations of their properties, oxides were finally found which, when heated, emitted an intense light and at the same time were tough enough to construct a mantle of. Auer von Welsbach took out his first patents for glow lights or gas mantles made of thorium and cerium oxides in 1886. Edison constructed the first successful filament for an incandescent lamp out of a charred bamboo filament, but now the demand is for more light from the incandescent bulb, and the tantalum lamp and the tungsten lamp are already practically successful and others will follow.

So much for the contributions of chemistry to the art of illumination. I might take the matter of food chemistry and show some most interesting developments. How larger and better corn crops are now produced than formerly, due in part to the application of chemistry to corn breeding; how the sugar beet has been raised from 6 per cent. to 8 per cent. of sugar content, to 18 per cent. or 20 per cent.; how the sugar cane and the cereals are being improved; how the scientific application of fertilizers is maintaining soils in a state of fertility; and how the great science of soil chemistry is developing with enormous rapidity. Think what that means. It means the food-supply of future generations and life and health to them. Agriculture is fundamental in human affairs, and chemistry is fundamental in scientific agriculture.

In every branch of human knowledge and activity, the influence of chemistry is making itself felt. Under its influence the people are beginning to note that it is the composition of things, not appearances and not names, that is important. I am as great an admirer as any man of the human imagination in science and in art. I am capable of appreciating keenly the romance in literature and impressionism in painting, and I can enjoy, too, that combination of romance and impressionism which the advertising man places before our vision in vending his wares. I am capable

of enjoying these things, I say, as fiction. Imaginative advertising, as advertising, has delighted me from the start. I have read them all from "Sunny Jim" to the "Gold Dust Twins." But, after all, could we not purchase more intelligently if we were better posted on composition and less on catch-phrases and cartoons? Is it too much to hope that chemical composition will one day be the public's guide in matters of this sort? Carnation milk, Violet wafers, Butternut bread, Bullfrog beer, Buttermilk soap and Grapenuts! I can see an opportunity for chemistry here!

In conclusion, there may be some present who will think I have praised chemistry and chemists too highly. Some may say that important matters speak for themselves and need no praising. I am not in the least of the opinion that chemistry needs praising; what it does require in this country is, calling the public's attention to its importance.

W. D. Richardson

SOME RESULTS OF THE MAGNETIC SURVEY OF THE UNITED STATES[1]

The United States of North America, embracing nearly one fifteenth of the entire land area of the globe, or an area about equal to that of Europe, constitutes at present the largest land area for which a general magnetic survey, in sufficient detail and of the requisite accuracy, has been made. The three magnetic elements: the magnetic declination, the inclination and the intensity of the magnetic force, have been determined at about 3,500 fairly uniformly distributed points. Of this number of stations about two thirds were occupied during the seven years the speaker had charge of the magnetic operations of the United States Coast and Geodetic Survey, viz., 1899–1906.

[1] Presented before the National Academy of Sciences, Washington, D. C., April 22, 1908.

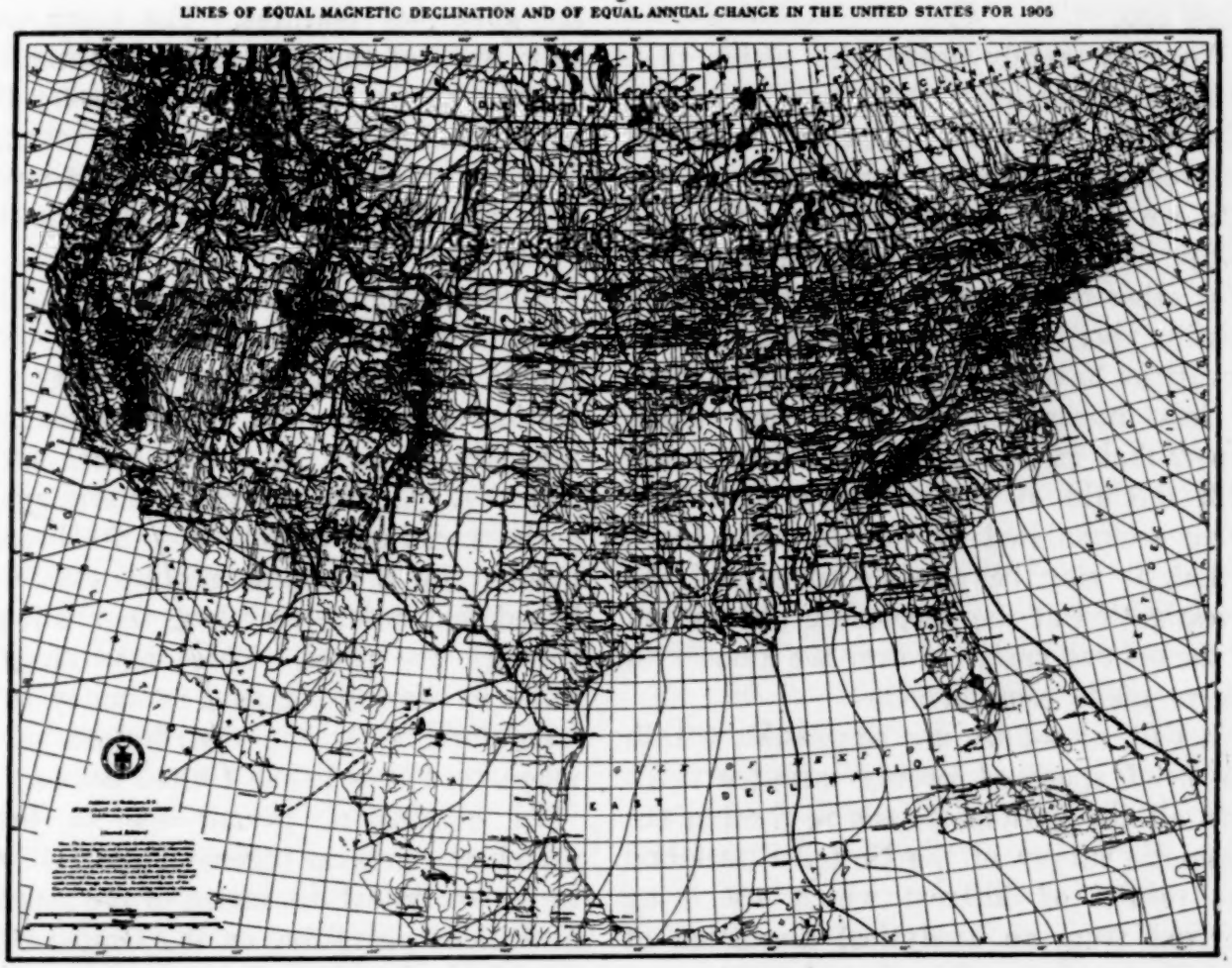
The stations are, on the average, thirty to forty miles apart, or we may say there is, on the average, one station for every 900 or 1,000 square miles. Of course, in some states, *e. g.*, in the coast states, the distribution of stations is somewhat denser than in some of the interior western states, because the early magnetic work of the Coast Survey was largely confined to the Atlantic and Pacific coasts. However, before many years the distribution for all the states will be practically the same. When this has been accomplished, the plan is to multiply stations in the regions of manifest irregularities. (Two slides were exhibited, one showing the distribution of the stations up to 1899 and the other up to January 1, 1907.)

Because of this large amount of accurate magnetic data now available for the United States, I was enabled to construct the magnetic maps of the United States, for the first time as based upon strictly reliable and homogeneous data. My predecessor, the late Charles A. Schott, who had been a member of this academy, was obliged to base his isogonic maps or "lines of equal magnetic declination" very largely upon surveyors' data, owing to the paucity of data, whereas his isoclinic and isodynamic maps had to rest upon even more slender material. In the present instance, however, the charts of the various magnetic elements all depend upon practically the same number of observations made at the same points. They are, hence, strictly comparable and we may, therefore, pursue our investigations respecting the irregularities in magnetic distribution much more successfully than hitherto.

Mention should also be made that during the period 1899–1906 special attention was paid to instrumental errors—more frequently inherent in magnetic instruments than generally supposed. All instruments were therefore studied care-

fully and inter-compared and the necessary corrections on standard instruments frequently obtained. It was also recognized that in magnetic survey work one of the chief aims must be to *multiply* stations in order to eliminate, as effectually as possible, station errors which frequently far exceed observation errors. The time previously spent at a station was reduced from

LINES OF EQUAL MAGNETIC DECLINATION AND OF EQUAL ANNUAL CHANGE IN THE UNITED STATES FOR 1905



two or three days to one day or two days so as to permit doubling or trebling the number of stations per month. By properly systematizing this work and depending for certain corrections upon magnetic observatories established at the same time, it was found that the increased speed in the execution of the work brought about no sacrifice in accuracy. In fact, owing to the care bestowed upon the instrumental errors as well as on other parts of the work, the general accuracy of the work subsequent to 1899 has distinctly advanced.

Another feature enhancing the value of the present maps is due to the fact that in addition to the observations on land, magnetic work at sea was inaugurated in 1903 on the Coast Survey vessels. There were, hence, available the magnetic results obtained by these vessels along our coasts during the four years 1903–1907, as also the results obtained by the Carnegie Institution of Washington, in Canada, Mexico, Central America, and on the Pacific Ocean. (Slide 3 showed the progress to date of the ocean magnetic work.)

The present magnetic maps apply to the date January 1, 1905. In order to be able to refer all observations to this date, as accurately as possible, special attention was paid to the secular variations of the mag-

netic elements and, accordingly, stations were reoccupied at closer intervals in time, as well as in distance, than had previously been the custom. In consequence, certain unexpected and complicated features of the secular variation could be satisfactorily delineated. It was found that the secular variation had not, in general, progressed in accordance with the predictions from the empirical formula established ten years ago.

We may safely make the claim that in no other country than ours have the phenomena of the secular variation received such careful investigation; the data we possess, in consequence, for this study are unrivaled. Unfortunately, in most other countries, owing to the lack of existing, permanent organizations, the observations have had to be prosecuted more or less intermittently. It is very much hoped that in about ten or fifteen years with the aid of the magnetic data now being accumulated by the Carnegie Institution, it may be possible to extend the investigation of the perplexing phenomena of the secular variation over the globe with the requisite completeness.

It will, of course, not be possible within the brief space of twenty minutes to go into all the various details respecting the magnetic survey of the United States and the results of interest which are being derived from an analytical discussion of the observations. We shall have to content ourselves with the consideration of but one or two of the more important phases of the work.

You have before you one of the magnetic maps constructed on the basis of the available material—the "Lines of Equal Magnetic Declination and of Equal Annual Change for January 1, 1905" (Slide 4). What impresses one most is, doubtless, the manifold irregularities and twists in the various lines. Increased knowledge teaches us that the more numerous the observations the more devious become the lines of equal values. When you see perfectly regular or smoothly flowing lines you may rest assured that they have been either smoothed out or conventionalized or that they depend upon but very few data. Instead of the irregularities being the *abnormal* features, *they* are the *normal* ones, and *regularities* are, in fact, the *abnormal* features. The ocean magnetic work of the Carnegie Institution has likewise shown that practically every land mass exhibits irregularities in magnetic distribution over that which would prevail were the same region covered with deep water.

Similar magnetic maps to the one shown have been constructed for the dip or inclination, the horizontal intensity, the vertical intensity and the total magnetic intensity, as well as certain other special maps, *e. g.*, the magnetic meridians or paths traced out by following the direction pointed by a compass needle, etc. It is hoped that before very long they will pass through the press. These new maps all unite in bearing common testimony to the irregularities in the distribution of the magnetic forces in the United States.

In conclusion, permit me to briefly sketch the general scheme I am following in the analytical discussion of the magnetic conditions prevailing in the United States as exhibited by these maps. Some of you are familiar with the general analytical treatment by spherical harmonics of the earth's magnetic condition, at any stated period, initiated by Gauss. You will doubtless recall that he carried the expansion of the potential to terms of the fourth degree, inclusive, thus involving twenty-four coefficients to be determined by a least square treatment of the available magnetic data. The later analysts have extended the expansion to terms of the

sixth order, inclusive, hence determining forty-eight coefficients. However, in spite of the increase in the number of terms and coefficients, the results as computed from the formula differ from the observed quantities to such an extent that no *practical* use, whatsoever, can be made of them. For example, in the United States the formula would give magnetic declinations differing at *least* 1° to 3° from observed values.

Gauss's formula has only a certain theoretical significance, but, as said, no practical value as an interpolation formula. Why is this? Is it due to imperfection or incompleteness of the underlying data? Yes, to a certain extent. For example, all of the various analyses to date have had to be based on maps depending largely on land data, *i. e.*, on data covering but a fourth of the area of the globe. Nothing was known as to the reliability of the map data over the remaining three fourths—the ocean areas. Thus the Carnegie Institution work has shown that the magnetic map data over the Pacific Ocean are erroneous 1° to 3° in declination and dip, and about one twenty-fifth part in horizontal intensity. So we may confidently expect some improvement with the later more accurate data and it is possible that a new formula as based upon these data will give results sufficiently close in agreement with observation over the ocean areas for *practical* purposes if not for *scientific* purposes.

When we come to *land* areas, however, it is questionable whether any general terrestrial formula can be established which will represent the land observations sufficiently closely, even if the expansion be carried farther than it has already been, viz., beyond the sixth degree. The prime reason for this has been made evident from our study of the magnetic field of the United States. We find, namely, that we must deal with irregularities in magnetic distribution of various gradations covering areas of varied extent, a locality, county, state or an entire continent. Thus we may have the magnetic forces observed at any given point in the United States as the resultant effects of (1) a general or terrestrial magnetic field due to the general magnetic condition of the earth, (2) a general, terrestrial disturbing cause which distorts the general magnetic condition of the earth at the place of observation, (3) a continental disturbing effect, due largely to that portion of the North American continent above the general ocean bed, (4) a regional disturbance due to low-lying magnetized masses or earth currents covering a certain region, and (5), a local disturbance due to the magnetized masses or currents in the immediate vicinity.

Now a formula based upon the entire earth can, of course, not include also disturbances of such restricted areas as embraced under the last two heads, viz., regional and local disturbances, but it appears that the present formulæ do not even adequately represent the *continental* effects. In these formulæ we have the various terms advancing and recurring by trigonometric functions of multiples of the longitude and the latitude. Thus a term involving six times the longitude is supposed to continue around the earth six times in unaltered manner. However, such a term arising from the North American continental shelf which in the United States has a width in longitude of about 60°, would not continue around the earth, but would in all probability die out before the European or the Asiatic continent is reacned. In other words, it must be recognized that with the recurrent or continuous terms embraced in the higher harmonics of Gauss's formula, we can at the best but "counterfeit" the facts of nature but never get at the actual truth.

Here we are brought face to face with the question: How far is it really worth while to go in the establishment of the formula? The geodesist contents himself with the determination of at most two constants for the figure of the earth. No one, to my knowledge, has succeeded in establishing a formula which represents the actual shape of the earth and exhibits at least the most marked of the earth's manifest irregularities of surface. Professor Love, I believe, has established a formula representing the irregularities of the first, second and third degrees, but has not deemed it worth while to go beyond this extent. And so it would appear to me that the time has come to halt in the establishment of a complex formula involving forty-eight unknowns or more which at the very best can give but an inadequate representation of the actual facts of the earth's magnetism. It would seem more logical to stop with a certain finite number of terms involving a limited number of unknowns which represent, from a physical standpoint, the chief and principal facts of the magnetic condition of the earth. The magnetization resulting from this limited expression we should call our "normal field," or "field of references" as the geodesist calls his adopted figure, the *spheroid of reference*. The residuals from this field of reference would then receive separate or special treatment in accordance with their extent and their character. In conclusion an application of this mode of treatment to the United States was shown (Slide 6).

L. A. Bauer
The Carnegie Institution of Washington

SCIENTIFIC BOOKS

Revision of the Pelycosauria of North America. By E. C. Case. Publication No. 55 of the Carnegie Institution, Washington, July, 1907.

This important monograph deals with the most remarkable group of the Permian vertebrata. The Pelycosauria, popularly known as "fin-back lizards," have been known hitherto only from brief and scattered descriptions principally by the late Professor Cope, mostly based upon very incomplete material. Dr. Case's studies of the last few years, aided by a grant from the Carnegie Institution, have done a great deal towards clearing up our understanding of the structure and relationships of the order. In the present memoir he has brought together all the earlier descriptions, and has redescribed and fully illustrated all the better-known types from the more complete material now available.

The rich and varied vertebrate fauna of the Permian beds of northern Texas and the adjacent parts of Oklahoma was first made known to science by Cope in 1878 and succeeding years. The collections upon which his earlier descriptions were based were obtained for him by Jacob Boll and J. C. Isaac in 1878–80, and by Professor W. F. Cummins, the well-known Texas geologist, in 1881–4. In 1895–7 Professor Cope's collections were greatly increased by the energy of the indefatigable collector, Charles H. Sternberg. All these collections are now in the American Museum of Natural History, along with additional material since obtained by Mr. Sternberg and Dr. Case. Dr. Case has also made considerable collections for the University of Chicago, and the Paleontological Museum of Munich has acquired a large and valuable collection through the exertions of Mr. Sternberg. So far as the reviewer is aware, there are no important collections of vertebrates from the Texas Permian, except in the three institutions named. The preparation of the specimens for study or exhibition is exceptionally difficult and tedious, since the bones are usually encased in a hard flinty concretion which can be removed only by laborious and painstaking chipping. The progress of our knowledge of this wonderful fauna is greatly hindered by this difficulty in preparation.

The vertebrate fauna of the Texas Permian consists chiefly of armored amphibians (Stegocephalia), large and small, and primitive reptiles of several groups. Its prime interest lies in the fact of its great antiquity.

The Permian is the oldest fauna of land vertebrates of which we have any extensive knowledge, illustrates the early stages in the adaptation of the vertebrate phylum to terrestrial locomotion and shows us what the early land vertebrates were like from which the various orders of reptiles and mammals are more or less directly descended. It is from the study of the reptiles and amphibia of this period that we shall obtain the best evidence regarding the relationship of the several orders of reptiles and the origin of the mammals.

The typical Pelycosauria are better described as archaic rather than primitive, since, while for the most part remarkably primitive reptiles, they are in certain respects highly specialized. This is especially seen in the enormously elongated neural spines of the vertebræ, which form a high rigid bony fin on the back, and in the differentiation of the dentition by enlargement of certain teeth to serve as canine teeth, as in carnivorous mammals. This specialization of the dentition is correlated with great changes in the form of the skull and the proportions of its bones, and the development of the back fin, with reduction of the tail and adaptation of the feet and limbs to more truly terrestrial locomotion.

The two best-known genera are *Dimetrodon* and *Naosaurus*. In the first the spines are very long, slender and simple; in the other they are not quite so long, but stouter, and provided with a series of short cross-bars like the yards of a full-rigged ship. *Dimetrodon* is known from the complete skeleton; in *Naosaurus* the proper correlation of the skull is in doubt. These animals were of fairly large size, six to eight feet in length, massively proportioned, the head high, compressed, nearly a foot long in the largest species of *Dimetrodon,* with fin spines over three feet long. Dr. Case considers that the spines must have been connected by a web of tough horny skin, but were probably not covered by flesh. No satisfactory explanation of the use of this fin has been given; the author regards it as illustrating Beecher's law of the exuberance of spines and bony outgrowths in the last stages of evolution of a race. These genera are the extreme stages in the specialization of the pelycosaurs. They are connected by a series of intermediate forms with small aquatic unspecialized types related to *Protorosaurus, Palæohatteria* and other primitive reptiles of the Permian of Europe.

The inclusion of the early stages of the Pelycosaur phylum in the order Pelycosauria is, in the reviewer's opinion, open to some objection. These small primitive genera are structurally ancestral to the typical Pelycosaurs (they are not genetically so, as Dr. Case is careful to point out, since so far as we know they are all contemporaneous), but that is no reason for including them in the order. An order, genus or species is defined by certain facts of common structural peculiarities indicative of descent from a common ancestor and by certain acquired specializations indicative of similar adaptation. The ancestor is a member of the phylum, but not necessarily of the order; it may belong to a more primitive order which has given rise to one or more specialized orders of a later epoch. Unless we hold to this view of their limits it becomes impossible to properly define natural groups. In the opinion of the reviewer the Pelycosauria could be more satisfactorily defined if these primitive genera were left out, to be placed perhaps in the Protorosauria, from which the Pelycosauria would be, structurally speaking, derivable.

The author confirms the views previously expressed by himself and by Osborn as to the general relationship of the order. They belong to the primitive Diapsidan or Rhynchocephaloid group of the Reptilia (superorder Diaptosauria Osborn), *Sphenodon* being the nearest modern relative. Their relationship to the Cotylosauria is more remote than supposed by Cope, and the inclusion of both groups in an order Theromora is inadmissible. Substantially the same views are expressed in recent contributions to the classification of the reptilia by Broom[1] and by Boulenger[2] as

[1] "Classification of the Theriodonts and their Allies," Rep. S. Afr. Assoc. Adv. Sci., 1903.

[2] "On the Characters and Affinities of the Triassic Reptile *Telerpeton elginense*," *Proc. Zool. Soc. London*, 1904, p. 470.

to the position of the Pelycosauria. Broili, however, in his recent memoir upon Permian Stegocephalia and Reptilia of Texas[3] and elsewhere[4] is inclined to hold to the classification of Cope and include them with the Cotylosaurs and Anomodontia in the Theromorpha (Tharomora) as quite nearly related primitive groups.

Dr. Case has shown a praiseworthy conservation in the manufacture of new species, and the tabular and descriptive differentiation of the families, genera and species full and clear. The quality of the illustration varies widely—some of the drawings are excellent—most of the photographic work is poor. The sketch restorations of the better-known genera assist greatly in making the subject clearer. The type revision leaves somewhat to be desired as to method and clearness; it would have been an aid to systematists if the author had differentiated his "types" more clearly, according to the excellent nomenclature given by Schuchert.[5] Some of Dr. Case's "types" are holotypes, others neotypes; "co-type" means sometimes paratype, sometimes neotype, never "co-type" in the generally accepted sense of the word. Many of the original types (holotypes and paratypes) are indeterminate, or unidentifiable, and the species are either indeterminate or rest upon neotypes, but this should have been clearly stated in each case. Lack of clearness in this subject is liable to mislead systematists and compilers who might suppose it necessary to make changes in nomenclature. The reviewer, in preparing a catalogue of the types in the Cope collection, has not found this necessary.[6]

[3] *Palæontographica*, Bd. LI., 1904.

[4] "Stammreptilien," *Anatom. Anz.*, Jena, 1904, Bd. XXV., p. 577.

[5] Science, 1897, p. 636; "Catalogue of Type Specimens in the National Museum," Bull. U. S. Nat. Mus., No. 53, part 1, preface.

[6] *E. g.*, Case refers *Sphenacodon* Marsh to *Dimetrodon* Cope, which it antedates; and *Clepsydrops limbatus* to *Dimetrodon incisions*, a later described species. If definitely referable, this would invalidate both the genus *Dimetrodon* and the species *incisions*. But the older genus and species are in fact regarded as indeterminate and should have been so placed in the synonymy.

Altogether the memoir is a very valuable and useful contribution, and a great step forward in our knowledge of the Permian Vertebrata. As the author premises, we are by no means yet in a position to revise and describe the Pelycosauria in any final and conclusive manner. Nevertheless, his conclusions in regard to the position and relationship of the order are not likely to be very radically altered by future discoveries. It is to be hoped that the remaining groups of Permian vertebrata will be similarly studied and monographed in the near future.

Accurate stratigraphic work is also very much needed in this field. Little is known of it except through the reports of Professor Cummins in the Texas Survey, which, on account of limited time and means and the extensive field to be covered, are of a preliminary and general character and have not been satisfactorily correlated with the paleontological work and with stratigraphic work in adjoining regions. Dr. Case has recently published[7] some preliminary data for more exact stratigraphic work, and Dr. I. C. White in his studies upon invertebrata[8] and Dr. Broili upon the vertebrata[9] have published some valuable stratigraphic observations upon the typical region. Dr. Geo. I. Adams[10] has also made a preliminary correlation with the work of Taff[11] and Gould[12] in Oklahoma. But much more remains to be done before we can arrive at any adequate understanding of the faunal levels in the formation and the evolution of the various phyla during the period.

W. D. Matthew

Mental Pathology and Normal Psychology. By Gustav Störring. Translated by Thomas Loveday. Pp. 298. Swan Sonnenschein and Co. 1908.

In spite of the very general and increas-

[7] *Bull. A. M. N. H.*, 1907.

[8] *Amer. Nat.*, 1889.

[9] *Palæontographica*, 1904, Bd. LI.

[10] *Bull. Geol. Soc. Am.*, 1903, 191.

[11] U. S. G. S., Professional Paper No. 31, 1904.

[12] U. S. G. S., Water Supply and Irrigation Paper No. 148, 1905.

ing interest in the topic of abnormal psychology, there have been practically no summaries of doctrine suitable to the use of students approaching this topic from the psychological point of view. The literature is a medical one, appealing to the alienist; and from this the psychologist has had to gather his material and make his interpretations. The appearance of Dr. Störring's lectures to students at Leipzig was one of the first attempts to bring within reasonable compass some of the aspects of this topic that would be pertinent to students with predominant psychologic interests. It was natural that a contribution of this kind should attract the translator; and the English edition of the work will be welcomed as a valuable resource to professional teachers of psychology. The work quite naturally does not meet the needs of American students as nicely as would a book written with reference to the attainments of the advanced undergraduate and the graduate student in our universities. The attitude of the German lecturer and the mode of handling his data, as well as the maturity of apprehension and general familiarity which he assumes, often go beyond what may properly be expected in an American class-room. As a text the volume will be used *faute de mieux;* but as a book of reference upon the shelves of even a limited psychological library the book merits a well-deserved place. The selection of topics is well considered and the perspective of importance of the data well maintained. There are not that clearness of description and patient exposition of relation which students often expect and which the American lecturer takes such pains to supply. The delineation of symptoms as deviations of mental procedure is given first prominence, though the place of these in actual complexes (disease pictures) is not slighted. Special psychic disorders (notably the delusions and hallucinations, the aphasias, the phobias and functional aberrations) are likewise succinctly presented. The translation is commendable. J. J.

Attention. By W. B. PILLSBURY. Macmillan. 1908. (Library of Philosophy.) Pp. 346.

Professor Pillsbury's monograph on "Attention" appeared in French as a volume of the Library of Experimental Psychology. The valuable character of the work was commented upon in a review of the French edition. The English volume is an expansion of the former work and increases notably the value of this contribution to psychology. There is an additional chapter on measurements of the attention, a very important topic; a similar addition treating of the relation of attention to the feelings and to the self, and a useful practical chapter upon the educational aspects of attention. What appeared as a single chapter in the earlier publication on memory, will and reason, is now amplified into three separate chapters. With these additions, the work becomes a complete and admirable handbook to a well-rounded treatment of a topic of prime importance to the student of psychology. Naturally the topic is so central to the group of problems that constitute modern psychology that the work touches upon many of the vital issues of a growing science, and summarizes a body of doctrine indispensable to the right understanding of what mental processes are. The point of view of the author remains unchanged and takes a conciliatory stand with reference to the conflicting views of the nature of the attentive process as hitherto presented. The volume may be emphatically commended.

J. J.

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for March has an article by Bashford Dean on "The Lamarck Manuscript in Harvard" which comprises five papers and nineteen plates. Douglas H. Campbell discusses "Symbiosis in Fern Prothallia" and Charles Depéret presents the second paper on "The Evolution of the Tertiary Mammals and the Importance of their Migrations," this paper dealing with the evidence in the Oligocene of France. Henry L. Bolley has some "Observations regarding the Constancy of Mutants and Questions regarding the Origin of Disease Resistance in Plants" and S. W. Williston discusses "What is a Species," giving a new and elaborate defini-

tion too long to be quoted in full. H. S. Jennings gives a most interesting review of "Recent Work on the Behavior of Higher Animals."

The American Museum Journal for May has an excellent and well-illustrated article on "The Use of the Chilcat Blanket," by Geo. T. Emmons, a notice of "New Material from the Congo Free State" and a note on "Preserved Tattooed Heads of the Maori of New Zealand." "Museum News Notes" tell of the various expeditions that are in the field or are about to set out.

The Bulletin of the Charleston Museum for April is mainly devoted to an article by Herbert R. Lass on the "April Bird Life of Otranto." Eighty-one species were observed in three days, the most interesting being the snake-birds which have but recently established themselves in this locality.

The contents of the March issue of *Terrestrial Magnetism and Atmospheric Electricity* are: Portrait of Michel Rykatchew (frontispiece); "Some Microseismic Tremors and their Apparent Connection with Barometric Variations," by John E. Burbank; "Magnetic Survey of the Dutch East Indies" (sixth communication), by W. van Bemmelen; "Biographical Sketch of Michel Rykatchew"; "Störmer's Work on the Physics of the Aurora," reviewed by P. G. Nutting; "Is the Earth's Action on a Magnet only a Couple?" by L. A. Bauer. Letters to the Editor: "Principal Magnetic Storms recorded at the Cheltenham Magnetic Observatory," by O. H. Tittmann; "The Magnetic Character of the Year 1906," by E. van Everdingen. Some of the early issues of *Terrestrial Magnetism and Atmospheric Electricity* have been reprinted so that complete sets can be again supplied. Orders should be sent to the Johns Hopkins Press, Baltimore.

SOCIETIES AND ACADEMIES

THE UTAH ACADEMY OF SCIENCE

On the evening of Friday, April 3, the Utah Academy of Science was organized in the auditorium of the Packard Library, Salt Lake City. A constitution was adopted and the following officers were elected:

President—Dr. Ira D. Cardiff, University of Utah.

First Vice-president—Dr. John A. Widtsoe, Utah Agricultural College.

Second Vice-president—Dr. S. H. Goodwin, Proctor Academy.

Secretary—A. O. Garrett, Salt Lake High School.

Treasurer—E. M. Hall, L. D. S. University.

Councillors—Dr. John Sundwall, University of Utah; Dr. E. D. Ball, Utah Agricultural College, and Dr. W. C. Ebaugh, University of Utah.

Three sessions were held, during which the following program was given:

"The Primordial Element: A Recurring Hypothesis," by Dr. W. C. Ebaugh.

"Origin and Distribution of the Flora of the Great Plateau," by Professor Marcus E. Jones.

"Results of Some Investigations of Parasitic Insects," by Professor E. G. Titus.

"Notes on the Nesting Habits of the Genera *Bombus* and *Osmia*," by Dr. Thilena Fletcher Homer.

"The Origin of the Homopterous Fauna of the Desert," by Dr. E. D. Ball.

"Rusts and Smuts of Salt Lake and Adjacent Counties," by A. O. Garrett.

"Concerning the Radiation from the Nernst Lamp," by Dr. L. W. Hartman.

"Refractory Clay, and the Effects of Ingredients upon the Melting Point," by A. F. Greaves-Walker.

"Recent Researches bearing upon the Physical Basis of Heredity," by Dr. Ira D. Cardiff.

"Researches on Gland Cells," by Dr. John Sundwall.

A motion was carried empowering the council to make arrangements for a July excursion to some of the near-by points of interest.

A. O. Garrett,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The forty-eighth regular meeting was held at the Ebbitt House on Saturday evening, March 28, at eight o'clock. Previous to the meeting a dinner was served to the members present.

The first paper on the scientific program was by Mr. A. S. Hitchcock, entitled "Grass

Types in the Herbaria of Linnæus and Michaux."

During the spring of 1907 the speaker visited various European herbaria for the purpose of studying the type specimens of American grasses. The present paper included an account of the types in the herbaria of Linnæus, at the rooms of the Linnæan Society in London, Gronovius, and Sloane, at the British Museum of Natural History at South Kensington, Swartz at the Stockholm Academy of Science, and Michaux at the Museum of Natural History at Paris. It is well recognized that in the taxonomic investigation of any group of plants it is necessary to determine with certainty the identity of the species described by the older authors. This identification in many cases can be made only by consulting the type specimens. The speaker endeavored from the data at hand to determine for each species the nomenclatorial type specimen. The type specimen is the specimen or one of the specimens from which the author drew up the description. This specimen often supplements or interprets the description which may have been insufficient to identify the species. The Linnæan species of American grasses are nearly all founded upon definite type specimens collected by Kalm, marked by Linnæus with a "K," by Patrick Browne, marked by Linnæus "Br.," and by Clayton, who furnished specimens to Gronovius. Linnæus usually writes a short diagnosis, followed by citations of synonymy: For example, *Panicum dissectum* L. Sp. Pl. 57, 1753, under which Linnæus gives a diagnosis of his own followed by three synonyms, Roy. lugdb., Pluk. mant. t. 350, f. 2, and Sloane, jam, t. 69, f. 2, and finally habitat in Indiis. In the Linnæan herbarium is a specimen upon the sheet of which Linnæus has written "dissectum" and "K." This specimen, from Kalm, is the only one labeled dissectum by Linnæus. Is this the type specimen? The plant is what has been going under the name of *Paspalum membranaceum* Walt. The diagnosis given by Linnæus applies, but is too short to be satisfactory, but his later description, given in the second edition of the "Species Plantarum," leaves no doubt that he refers to the preserved specimen. On the other hand we find that none of the three synonyms cited applies to the specimen. We are therefore justified in regarding the preserved specimen as the type specimen of *Panicum dissectum*. It is true that Linnæus erred in giving the locality as the West Indies, an error which doubtless was based on his Sloane citation.

Paspalum paniculatum L. Syst. ed. 10. 855. 1759. The description is a two-line diagnosis followed by "Sloane, jam. t. 22. f. 2." Some botanists have considered this name to be founded upon the cited Sloane figure, the type of which is at the British Museum and is *Panicum fasciculatum* Sw. But a comparison of the Linnæan diagnosis with that of Sloane shows that they are not at all the same, and that furthermore the former description applies to the plant preserved in the Linnæan herbarium, from Browne, and not to the Sloane plant, hence the Linnæan plant is the type.

Panicum dichotomum L. Sp. Pl. 58. 1753. In this case Linnæus has no diagnosis of his own, but commences with a citation from Gronovius. Hence the type specimen is not the Linnæan specimen (which is not what has been going under the name of *P. dichotomum*) but is the Clayton plant in the British Museum which is the basis of Gronovius's description.

The paper included a discussion of several other cases taken from studies upon the types of Linnæus, Swartz and Michaux.

The second paper was by Mr. W. J. Spillman, who discussed "The meaning of 'elementary species.'" This paper is expected to be published in full in SCIENCE.

HAVEN METCALF,
Corresponding Secretary, pro tem.

THE CHEMICAL SOCIETY OF WASHINGTON

THE 182d meeting of the Washington Section of the Chemical Society was called to order at the Cosmos Club on Thursday, April 9, at 8 P.M. President Chamberlain presided, the attendance being forty-seven.

The following paper was read by Mr. Wade: "Distribution of Nutrients in a Soil," by G.

H. Failyer, J. G. Smith and H. R. Wade. The authors showed the composition of the different separates—clay, silt and sand. The amount of CaO, MgO, K_2O and P_2O_5 is greater in the finer separate—clay. The mechanical composition of two soils might be the same, and yet these soils might be very different chemically, and *vice versa*.

The meeting adjourned to meet at the Chemical Laboratory of the Johns Hopkins University, Baltimore, on Saturday, April 11, at 8 P.M., at which time Professor H. N. Morse addressed the members on "Osmotic Pressure." Professor Morse explained the construction and use of the various apparatus necessary in carrying on his researches. After adjournment the members were given the privilege of visiting Professor Morse's laboratory, where other apparatus was examined. A resolution was passed thanking Professor Morse for his paper, President Remsen for his hospitality, and to the owners of the copper and petroleum works for allowing the members of the society to visit the works. Over fifty members from Washington attended the lecture, at which the attendance was over eighty.

J. A. LeClerc,
Secretary

THE ONONDAGA ACADEMY OF SCIENCES

At the March meeting of the Onondaga Academy of Sciences, Principal John D. Wilson spoke of the "Geographic Influences in the Development of America." He described the form and structure of the continent, its eastern mountain barrier, the three important gateways through them, the character of the people entering by each, the favorableness of the New York entrance, and its importance in regard to location, climate and character of the people entering, and the effect of the favorable environment upon the people. All of these circumstances led him to prophesy that New York will ultimately prove the largest and most important city in the world.

The secretary, Philip F. Schneider, spoke of "The Formation of the Diamond." He described the occurrence of the peculiar cubic carbon in the stony meteorites from Arva, Hungary and Novo Urie, Siberia, and in the iron meteorites from Youndegin, West Australia, and Smithville, Tennessee; also the subsequent discovery of diamonds in these and other meteoric irons, describing with special care the diamonds of the Cañon Diablo meteorite obtained by Foote, Huntington, Kunz and others. He next considered the various methods of producing the diamond artificially, speaking at length of the method so successfully employed by Moissan of utilizing the intense heat of the electric furnace and enormous pressure generated by the sudden cooling of molten iron, and of the experiments of Friedlander of stirring molten olivene with graphite and thus producing diamonds. The analogy between the artificial diamonds and their matrix and those of the meteorites strongly suggests a similar origin in nature. That diamonds will ultimately be proved to have been formed at great depth and under intense heat and pressure either in a magma of molten iron or of olivene is probable, although the careful development of this part of the lecture was deferred until the next meeting.

The following officers were elected:
President—John D. Wilson.
Vice-president—Charles W. Hargitt.
Secretary—Philip F. Schneider.
Corresponding Secretary—Franklin H. Chase.
Treasurer—Louise W. Roberts.
Librarian—Mrs. L. L. Goodrich.
Councillors—D. M. Totman and S. R. Calthrop.

F. H. Chase,
Corresponding Secretary

DISCUSSION AND CORRESPONDENCE

ARE PENSIONS FOR COLLEGE TEACHERS A FORM OF SOCIALISM

I regret to see in Science of April 24, an expression of opinion by Professor J. McK. Cattell about the Carnegie Foundation for the Advancement of Teaching which seems to be based on evidence that will not stand the test of a careful examination. The principle involved is familiar to economic students, for it lies at the basis of a much

discussed theory of distribution. What, it is often asked, is the important change demanded by social progress? One answer is: a fairer distribution of wealth and more income to individuals. The other answer is: improve the conditions under which men live so that each generation starts on a sounder basis with better health and fairer conditions for work. Those who hold the first view talk of economic equivalents and contend that gains in any quarter are followed by losses in others, so that modified social conditions give no net gain to the worker except as they increase his income. If I should say to a man holding this view that the introduction of a new food or better sanitation would improve the condition of workmen, he would reply that the cheaper food would be followed by a rise in rent or by lower wages, so that no net economic advantage would remain. I might grant this and yet contend that the main benefit of the change was not the added income but the better health that workmen would enjoy under the new conditions. If trolley lines opened up a new residential section it would also be contended that the cost of transportation to this district and the rise of land values in it would make the expenses quite as high as if the workmen remained in their old houses. Even if this be true it is not a matter of indifference to the workman and his family whether they live in a suburban cottage or in a few back rooms in a crowded tenement district. The conditions under which people live, their health and their vitality, are of far more importance than their income.

Let me illustrate this principle by an application to the university of which I am a member. During recent years salaries have risen from 15 to 20 per cent., but the cost of living has risen much more rapidly, say from 20 to 40 per cent. I do not think it an overstatement to say that the salary of a professor twenty years ago would purchase in goods and services $500 more than it will now. Measured in economic equivalents here is a distinct loss that should be the cause of deterioration. In fact, however, the very opposite has taken place in so marked a degree that it creates a veritable revolution. This change is plainly due to the better conditions under which teachers work. Twenty years ago Pennsylvania had practically no environment, the instruction was drawn from teachers' heads, there was little effective intercourse, no stimulus that called forth the best efforts of teachers, and no objective tests by which the progress and failures of students could be measured. Now we have a modern plant with laboratories, libraries, museums, dormitories, pleasant lecture rooms and other modern conveniences. It is this environment that has counteracted the depressing effects of low salaries and has given a tone to both teacher and pupil which no mere increase of salaries could have effected.

Suppose, for example, a university with fifty teachers should offer either to pay $10,000 a year for typewriters and similar helps, or to raise the salary of each teacher by $200. I doubt if there is a teaching body in the country that would not take the increase of salary, spend the money as they or their wives pleased, and go on with old methods of teaching, writing letters and keeping records. And yet I doubt if there is a single well-informed professor who would not admit that this use of the money would be far less effective in raising university standards than would the environing changes that a staff of typewriters brings about. The difficulty with the most of us is that we will not pay out our own money to get better environing conditions or to free ourselves from routine self-degrading work. But when these conditions are given, the best of us respond to the invigorating stimulus of a good environment and do work of a kind and character that lifts the tone of the university and its scholarship to new levels. Standards are thus set and comparisons made which force the less vigorous and more indifferent into new forms of activity. Soon the whole university feels the throb of a new life, better traditions are formed, the student body catches the new enthusiasm and goes out with better preparation, more efficiency and a greater love of work. All these are due to changes in the environment of teachers and not to the increase of salaries. Income is a

matter of small importance when compared with the conditions under which work is done.

The Carnegie Foundation is to be regarded as one of these environing conditions, the improvement of which has done so much for American education during recent years. It gives security and freedom from worry for wife and child, the lack of which has forced many a professor to sacrifice good work to the need of meeting some unexpected outlay for which his regular salary fails to provide. Sickness, accident, life insurance and other extraneous burdens have been met by work that forced the teacher to do some toilsome unremunerative task such as writing reviews at $2 a page, or hack work for publishers at similar rates. The pay for such work is usually not so high as could be obtained by ditch digging or street cleaning. I call to mind a friend who earned this extra cash by directing wrappers. He was secretary of a learned society that appropriated $300 a year for this purpose and he could not let the money slip through his fingers even at the cost of descent to degrading routine and poor health. The university paid him $5 an hour for its work; he earned his extras by working for ten cents an hour. Surely this is a fiasco calling for some environing change.

It also seems odd to me to call schemes for environmental improvement paternal and socialistic. The confusion of thought involved in these statements is due to not seeing clearly the difference between the provision which each age makes for its successors and the care and control which some individuals exert over their contemporaries. We can leave little to our descendants except better conditions, sound constitutions and a freedom to utilize the forces of nature and society upon which their daily lives depend. We make for them the conditions under which they work; the distribution of current income they must settle for themselves. Paternalism and socialism seek to control this annual recurring income and the activities of those who cooperate to create current wealth. Every scheme of social progress calls for a constantly improving environment; but every scheme can not therefore properly be classed as socialistic and paternal. Is it paternalism for parents to give their children a sound constitution? Should their children at maturity be allowed to choose between health and the present worth of a good body, say $20,000? Is the man who tries to buy his health with pills and nostrums superior to him whose health is a gift from his ancestors? Should universities say to professors, "you can have $200 a year or the use of the library; $1,000 a year or the use of a laboratory; $500 a year or the advantages of a cultured society"? And should they say to students, "we will give you $150 a year or the use of the dormitories and gymnasium, and $100 a year or the right to associate with your teachers and fellow students"?

The correct view is that the environing conditions of a university are the gift of past generations to the present. They do not limit the freedom of the present generation. On the contrary, they vastly increase it. So too is the home an accumulation of benefits which past generations give to the present. And all society, to a less degree but in the same way after all, is creating changes which accrue to the benefit of succeeding ages. The inheritance of an improved environment is civilization, not socialism. To confuse environmental change with the social control which socialism seeks to establish is an error that only clear thinking can avoid: but when we do see the contrast it becomes apparent that Mr. Carnegie has wrought for the college teacher a new and higher environment which will give him more freedom, greater zeal and better opportunities to raise the standards and ideals of the young men it is his duty to instruct. Pensions do not differ in effect from lecture rooms, libraries, laboratories, and other environing conditions of university life. May each generation for ages to come produce more men who will add to the efficiency of teachers and universities by bettering the environing conditions of teacher and pupil.

Simon N. Patten
University of Pennsylvania

THE LENGTH OF THE SMALLEST KNOWN SIRENIAN FETUS; GYRE PREFERRED TO "CONVOLUTION"

TO THE EDITOR OF SCIENCE: In the October issue of the *American Naturalist,* under "Scientific Exhibits at the Seventh International Zoological Congress," on p. 633, the fetal manatee shown by me is said to be "approximately an inch and a half long." Since this is supposed to be the smallest known Sirenian fetus it is proper to state that from the root of the flexed tail to the top of the flexed head, allowing two mm. for the depression caused by the removal of the brain, the present length is 53 mm., say two and one-eighth inches. It has shrunk about two mm. since the measurements recorded in the *American Journal of Science and Arts,* August, 1875, where also various aspects are represented upon Plate VIII. In accordance with the criterion applied to the developing human being by Minot ("Embryology," p. 391) this specimen should be called *fetus* rather than *embryo,* because the tail is unmistakably that of a manatee notwithstanding the marked flexures of both ends of the body and the resemblance of the head to that of a horse or other ungulate.

On p. 662 it is said that I "exhibited photographs of human cerebral convolutions." Do not think me over-particular in disclaiming responsibility for the last word. I would no more use "convolution" for *gyre* than "conflagration" for *fire.* The choice was made deliberately in 1881, and published on page 133 of the issue for March 26 of SCIENCE, (the original periodical of that name, of which only three volumes were published). It has been declared upon several subsequent occasions. It constitutes one of many cases of identity between my neural terms and the B.N.A., although the framers of the latter had not the grace to acknowledge the priority of nearly the fourth of a century.

BURT G. WILDER

ITHACA, N. Y.,
April 7, 1908

AMETHYSTINE GLASS

IN connection with the interesting information given in SCIENCE, February 7, p. 239, it may be worth while to call attention to the fact—first pointed out to me by Mr. Irish, of the normal school at Tempe, Arizona—that ordinary bottle glass, when left exposed on the ground out-of-doors in the arid southwest, assumes a strong purple or amethystine color. This I have observed in Arizona, New Mexico and Colorado. Dr. Shedd, when professor of physics at Colorado College, examined some of this glass which I had collected at Colorado Springs, and found that the color was discharged by heat. Many years ago, Faraday made some experiments with glass, noticing a similar change of color; but I have not seen any recent literature upon the subject.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

SPECIAL ARTICLES

SOME NOTES ON MALACOLOGICAL NOMENCLATURE

Two years ago I published a small paper on this matter.[1] On some points my eminent and most competent friend, Dr. W. H. Dall, does not agree with me, and I hope that these lines may contribute to concert between us. This would be the more desirable, as Dr. Dall without any doubt is actually the first among all the living malacologists whose knowledge extends to actual molluscan faunas as well as to extinct ones. Also the divergence of Dall and myself is not one of principle, but only caused by a different interpretation of the international rules.

Dr. Dall during the last years has made many efforts toward establishing names of ancient authors, more or less forgotten. The question in this case can not be that of the more or less convenience in accepting such names, but whether it is necessary to have no other rules for our manner of proceeding, than consequence and logic. Therefore we accept the most disturbing changes, but only in the case of true necessity, and this is not the case at all with such authors as Martyn, Humphrey, Link, Bolten, Mörch and others.

The international rules say in article 25:

The valid name of a genus or species can be only that name under which it was first desig-

[1] *Nachrichtsbl. der Deutsch. Malacozool. Ges.,* 1906, pp. 1–12.

nated in the condition: (*a*) that this name was published and accompanied by an indication, or a definition, or a description; and (*b*) that the author has applied the principles of binary nomenclature.

This rule confirms what has been accepted by zoologists a long time ago, that is to say, that *nomina nuda* shall not be regarded as established. Concerning the genera, all names given in catalogues without any definition are worthless. I am of the opinion that, also, species figured without the addition of any description can not be accepted. With respect to the generic names, Dollfus[2] is of the opinion that the worthless names rest without value up to the date that they are accepted in a valid publication of another author. This may be correct, but the examples given by Dollfus for the greater part must be refuted. He says that the names of Bolten and Link first acquired good standing in the catalogue of the Yoldi collection published by Mörch in 1852. This catalogue, however, having no definitions, is as completely worthless as the two others just mentioned.

All the generic names of this catalogue, and even some new ones, are given without diagnosis or any definition. Add to this that this catalogue is not at all a scientific publication, but the enumeration of a collection of shells which were to be sold in public auction in 1852. The catalogues also of Humphrey and Bolten are nothing but dealers' auction lists. It is not from such dim sources that science gets its fundamental elements. Quite in the same way, we might consider newspapers scientific publications.

The catalogue of the collection of Rostock studied by Link has never been published. The entire edition has been destroyed by fire and some proof-impressions have had the undeserved destiny of getting to be the object of scientific communications. The catalogue has never been reprinted, and even if it had been published, we could not attribute to it more value than to the similar elaborations of Bolten and Mörch. This opinion of the auction catalogue of the Museum Boltenianum has been expressed long since by the publications of P. Fischer,[3] W. Keferstein[4] and C. Semper.[5]

Dr. Dall has furnished no new data which could justify the rehabilitation of these rejected names. During my recent journey to Europe I have ascertained that my colleagues in this respect retain this opinion.

Another author who has been favored with the rehabilitation of his names by W. H. Dall is Martyn. As early as the year 1861 E. von Martens[6] asserted that the "Universal Conchologist" of Martyn has no authority, because the author is not strictly binomial. And I can find no reason to agree with Dr. Dall in thinking otherwise, being convinced that his arguments are unsuccessful. In this respect I have myself had an important experience. Working in ornithology, I have been impressed like almost all American ornithologists with the admirable publications of Brisson and I have endeavored to rehabilitate his names, but finally I have convinced myself that my endeavors must remain without success. Actually, I am completely sure that the international rules are perfectly in the right in driving from our nomenclature all the authors who are not strictly binomial. I regret this much in the case of Brisson but not in that of Martyn.

In my opinion, we not only have the right, but even the obligation to reject all the generic and specific names which are not formed exactly after the rules contained in article 25, and I therefore wish that Dr. Dall would give up his isolated position and follow the example of our other colleagues. I believe that he can do this so much the more easily, since nobody has contributed more to elucidate the systematic nomenclature than himself. Of all his works, nothing will be lost in this case, as these publications have been elaborated in such a conscientious manner that we need only eliminate the names of Bolten, Link, etc., and

[2] *Rev. Crit. Palaeozoöl. de Cossmann*, IX., 1905, p. 55.

[3] *Journ. de Conchyl.*, 1858, p. 206 ff.

[4] *Malacozool. Blatter*, X., 1862, p. 164 ff.

[5] *Verhand. d. Vereins f. natur. Unterhaltung, Hamburg*, V., 1875, p. 121.

[6] *Malacozool. Blatter*, VII., 1861, p. 141 ff.

take the next name proposed by a binomial author which is accompanied by a definition.

HERMANN VON IHERING

SÃO PAULO,
March 7, 1908

WITH the feelings expressed in the letter of my friend, Dr. von Ihering, I have much sympathy, as a quarter of a century ago I myself experienced similar feelings, expressed similar opinions and accepted as exact similar statements by older authors in regard to the publications of Link and some other authors, which greater knowledge and more experience have led me to regard as more or less erroneous.

To be brief, Dr. von Ihering asks us to reject all names unaccompanied by a diagnosis or definition.

But this is not the requirement of the international code of nomenclature. Excluding "diagnosis" and "definition" as universally accepted, the code also admits names "accompanied by an indication." Now, if an indication is not a diagnosis or a definition, what is it? Plainly, a recognizable figure or reference to another work where a figure, or definition, or both, will be found. I believe I am historically accurate in saying that the word "indication" was intentionally inserted in the code to cover exactly such cases. If it were otherwise it is clearly a superfluity in the paragraph of the code just referred to.

It can not be denied that the possession of an exquisitely accurate drawing of an animal, like those of Martyn, is calculated to give a far better knowledge of what the author had in mind than the three or four lines of dog-Latin, without a figure, often used by the ancient binomial authors.

And, if an author refers to page, plate and figure of a standard iconography, for the illustration and diagnosis of the animal he has in mind, in what respect is the diagnosis less effective than if it had been reprinted?

I am, therefore, confident that my friend's major premise is not well taken, but that the code expressly provides for such cases and properly accepts such indications.

We must remember that authors, from Linnæus to Lamarck, and even later, did not feel themselves obliged to accept the prior "nomen triviale" given by another author, but altered and changed to suit their own notions. Thus Gmelin, Lamarck and others borrowed Martyn's names, sometimes retaining his specific name, sometimes adopting his generic name, but rarely giving full credit. The binomiality of Martyn was not questioned by Gmelin or Lamarck, or other contemporaneous writers. I have shown that his names are quite as binomial as those of Linnæus. And von Martens, cited by Dr. von Ihering as rejecting Martyn, proposed to accept his *specific* names, while rejecting his *generic* names, because the latter conflicted with those which were more familiar. Martens himself was not above altering a prior generic name because it did not agree with his assumptions, and, though a most able and learned man, is not to be regarded as an authority on matters of nomenclature.

When a scientific man prepares an original systematic catalogue of a collection in his custody, is the scientific character lost because when that collection comes to be sold, this catalogue is printed for the use of buyers? I do not see why. An "auctioneer's catalogue" implies a catalogue made by an auctioneer and not by a scientific man. But Bolten, Hwass, Link and Mörch were scientific men, or even professors of zoology. Why then reject their work? I think each case must stand on its own merits.

In the case of Link, I formerly believed the tradition that the whole edition of the work had been burned, but I now think this tradition erroneous, on account of the number of copies of Link which have turned up. We have two in the National Museum library, and references to his system, which was taught to his students in the University of Rostock, are not very infrequent in the publications of his contemporaries. At any rate, Link, whose work was published as a university program, gives diagnoses and references to iconographies; so in that respect he is qualified to meet Dr. von Ihering's standard.

I have always been of the opinion that consistency required the rejection of Brisson's

names except when they had been validated by a binomial author.

I have rejected the names in the catalogue called the Museum Calonnianum, because it is anonymous, and because it was not issued by any named publisher, though we know it to have been based on a manuscript of Hwass and distributed by George Humphrey.

I have not found that accepting the international code in its full meaning and intention has isolated me from the majority of active workers in the line of my specialty. On the contrary, nearly all those who have had much experience with nomenclatorial matters have, like myself, with some reluctance, arrived at the conclusion that half measures will not do, that a thorough revision is the only way to arrive at permanency, and that each of us must do his share toward this desired result.

Wm. H. Dall
U. S. National Museum

P. S.—In order to make sure that my understanding of the rules is correct, I have applied to the secretary of the International Committee on Nomenclature, whose reply is appended.

Dr. Wm. H. Dall,
Smithsonian Institution,
Washington, D. C.

My dear Dr. Dall:

Referring to your letter relative to the points raised by Dr. von Ihering in regard to Article 25 of the International Code, I would invite your attention to a recent opinion rendered by the Commission, namely:

"*The meaning of the word* 'indication' *in Art.* 25a.—The word '*indication*' in Art. 25a is to be construed as follows:

"(A) with regard to *specific* names, an '*indication*' is (1) a bibliographic reference, or (2) a published figure (illustration), or (3) a definite citation of an earlier name for which a new name is proposed.

"(B) with regard to *generic* names, (1) a bibliographic reference, or (2) a definite citation of an earlier name for which a new name is proposed, or (3) the citation or designation of a type species.

"In no case is the word '*indication*' to be construed as including museum labels, museum specimens or vernacular names."

This opinion seems to cover the point of principle under discussion. It does not of course cover the point whether the particular authors mentioned by Doctor von Ihering are to be interpreted as coming under the principle in question. This latter point is dependent upon evidence, but I do not understand that you have asked me to express an opinion on the evidence.

Very truly yours,

C. W. Stiles,
Secretary, International Commission on Zoological Nomenclature
Washington, April 27, 1908

A NOTE ON THE ECOLOGICAL FORMATIONS OF PITTSBURG AND VICINITY

It has occurred to the writer, after reading a recent article in Science,[1] that a generalized classification of the vegetation of Pittsburg and vicinity, as presented recently before the Biological Section of the Pittsburg Academy of Science and Art, might be of interest to many botanists, especially teachers, who may be situated in regions whose land forms are similar to that of Pittsburg or whose vegetation may be classified in a similar manner.

Pittsburg is situated in a region whose soils are quite uniform so far as their chemical composition is concerned, being mainly derived from sandstones and shales, with a few thin strata of limestone, and it takes but little field work to convince one that the all-important factor in the formational structure of the vegetation is to be found in the different conditions of ecological habitats as brought about by physiographic processes. For this region, physiography, in the narrow sense of the term,[2] furnishes an efficient basis for an ecological classification of the vegetation; the details, but not the principles, of classification differing from those of "physiographic ecologists" elsewhere.

The main features of land form which need

[1] Ramaley, Francis, "Plant Zones in the Rocky Mountains of Colorado," Science, N. S., 26:642–643, November 8, 1907.

[2] Geomorphology—that part of physical geography, devoted to the form of the land—coordinate with oceanography and meteorology. See Davis, W. M., "Current Notes on Land Forms," Science, N. S., 25:70–71, January 11, 1907.

to be mentioned in this connection are briefly as follows: The tops of the main hills constitute remnants of an old Tertiary peneplain, now forming a horizon line at about 1,200–1,250 feet above the sea. This peneplain was elevated and dissected by drainage systems and, at the beginning of the Glacial Period, an advanced stage in the cycle of dissection had apparently been reached with wide valleys and graded streams, the latter being about 300–350 feet below the level of the old peneplain, in the Pittsburg region. The drainage system at that time consisted of the "Old Monongahela System," the outlet to which was towards the north to the present basin of Lake Erie.[1] With the blockading of this outlet by ice during the Glacial Period an outlet for this drainage system was effected westward and the Ohio River was formed, and, evidently associated with certain elevations of the land in this region, the drainage system was rejuvenated. This new cycle of dissection has now progressed in the region of Pittsburg to a stage marked by well-developed flood plains in the larger valleys at altitudes of about 720–750 feet above the sea, and about 200 feet lower than the flood plains which were built up during the Glacial Period, or soon after, on the old pre-Glacial valley floor. In the smaller tributaries, however, the streams are still engaged in actively cutting out a lower channel, the narrow recently-formed channel, often a gorge, being usually encountered in the upper third of the stream, while above this point the little streams are still flowing in approximately the same graded channels occupied by them during the existence of the Old Monongahela System.

The more important ecological habitats, as determined by their physiographic origin, and the corresponding ecological plant formations, are briefly as follows:

A. The tops and uppermost slopes of the hills, altitude of 1,050 feet or more above the sea, with a rather thin and infertile soil, are typically characterized in the vicinity of Pittsburg by the *Quercus alba* forest formation. As one stands upon one of the higher hills, this forest, easily recognized by its facies, the white oak, can be seen to comprise all that is left of the natural climax forest around the horizon.

B. Old valleys at the headwaters of the smaller streams of this vicinity, approximately remnants of the Old Monongahela System, at altitudes of not much less than 1,000 feet A.T., usually higher; soil somewhat deeper, more fertile, and more largely transported. This habitat is almost invariably occupied, in undisturbed positions, by the *Fagus-Acer* forest formation, the facies being *Fagus americana* Sweet and *Acer saccharum* Marsh., the beech consocies, however, being more important and often occurring almost pure in limited areas.

C. The narrow ravine or gorge with more or less vertical sides, as brought about recently and being continually extended at the end by the erosive activities of the rejuvenated streams; dark, damp, cool and rocky; elevation about 950–975 feet A.T., usually somewhere in the upper third of the smaller "runs." This habitat is occupied almost invariably by the *Tsuga canadensis* forest formation, the facies being the hemlock, *Tsuga canadensis* (L.) Carr. The transition from this forest formation to the *Fagus-Acer* formation is often as abrupt as is the change in the character of the habitats, neither formation being able to successfully invade the other without a corresponding modification of the habitats through physiographic processes.

D. The flood plains and terraces of the main rivers and, to some extent, continuations of these terraces into the lower parts of the tributaries, of the Old Monongahela System. This is the "900-foot terrace" of which considerable areas are still in existence in Pittsburg and vicinity. The soil is a deep, fertile, gravelly alluvium, usually so situated as to be well drained. This habitat is well characterized by the *Quercus velutina-Q. coccinea* forest formation, the facies being the black and scarlet oaks, respectively, the black oak consocies being the most important. This formation is considerably more dense and exhibits much more prominent layers than

[1] Leverett, Frank, "Glacial Formations and Drainage Features of the Erie and Ohio Basins," U. S. Geol. Survey, Monograph 41:88–100, 1902.

does the first-mentioned *Quercus alba* formation.

E. Talus slopes, at the foot of which are the flood plains of the modern larger rivers and tributaries; soil largely derived from other habitats by landslides, thus usually deep and more or less mixed with rock fragments. The upper part of this habitat, and often the newer or more unstable portions down to the base, is chiefly characterized by what may be termed the *Sambucus pubens* talus thicket formation; facies, the red-berried elder. In the lower portion of the habitat and in the more stable portions this formation is displaced, often plainly *succeeded,* by the next forest formation to be characterized.

F. The present flood plain of the modern rivers and larger tributaries; altitude of about 750–775 feet A.T.; soil a deep, sandy, moist, fertile alluvium. So far as can now be determined this habitat was formerly occupied by a climax *Acer-Ulmus* forest formation; facies—*Acer saccharinum, Acer rubrum, Ulmus americana.* This formation, as indicated by a few isolated remnants, was characterized by a greater number of tree species than any of the other forests of the region. Many large sycamores in this forest are to be regarded as relicts of the next formation.

G. The river banks and low islands subject to inundation during times of floods, especially in winter and spring. This habitat is characterized by the *Platanus-Salix* river-bank forest formation; facies—*Platanus occidentalis* L., and *Salix nigra* Marsh. With the meandering of the stream the habitat often is occupied by the *Acer-Ulmus* forest formation but the sycamores remain as relicts even after the succeeding forest has reached maturity.

H. The sand bars in the rivers, ordinarily covered by shallow water. This habitat is preeminently characterized by the *Dianthera americana* sand-bar formation; facies, *Dianthera americana* L. With the upbuilding of the bar this formation is succeeded by the *Platanus-Salix* river-bank formation.

Besides the above-mentioned formations there are several less conspicuous formations and no mention has been made of various successional formations, especially those of secondary successions incidental to the march of civilization, the purpose of this note being merely to designate the more important plant formations and to point out their correlation with certain conspicuous habitat-structures evolved in the physiographic development of the region.

Otto E. Jennings

Carnegie Museum

The "permanent phase"

For some time it has been generally admitted that all substances are capable of existing in the three phases, solid, liquid, vapor, and some substances, as sulphur, in four phases. We believe that all substances are capable of existing in four phases, and some in more.

To show this notion, we will use the common text-book phase-diagram for water shown in Fig. 1, in which, for the sake of clearness,

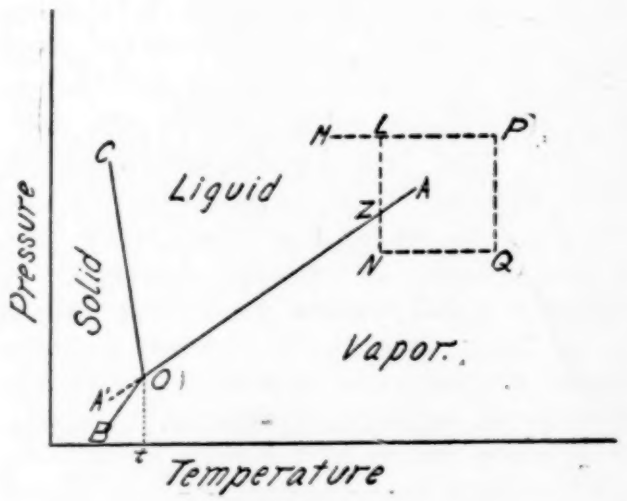


Fig. 1

the curves have been drawn as straight lines, and only the substance in a stable condition is considered. It will at once be seen that *OA* is the curve of vapor pressure that separates the region of liquid from the region of vapor. However, there is a limiting pressure beyond which the vapor pressure of the liquid can not rise, and therefore at the value of critical temperature and critical pressure *A* the curve *OA* abruptly ceases. It is commonly admitted that "for temperatures and pressures beyond *A* there is no distinction

between the liquid and vapor phase, the phases having become identical."

Let us take any value M in the region of liquid, and pass to any value N in the region of vapor; this may be done in a variety of ways and may therefore be represented by straight or curved lines in the figure. However, let us choose to pass from M to N by changing either pressure or temperature, keeping the other constant meanwhile.

First let us change the temperature to that indicated by the value N (which is value L). Now the pressure at L is greater than vapor pressure at constant temperature, therefore at L the substance is a liquid only. Then let us decrease the pressure to that of N. At the pressure and temperature Z where the line LN (LN being any line cutting OA), indicating the drop in pressure, intersects OA, the curve of vapor-pressure, there is a discontinuity in the passage, the phenomenon of "boiling" will ensue, and no further drop in pressure can take place until all of the substance is vaporized. Then the pressure can be lowered till the value N is reached.

If, on the other hand, we follow the line $MPQN$, which does not cut the line OA, we can pass from the state of liquid at M to the state of vapor at N, without any discontinuity whatever. We first increase the temperature, following the line MLP to a value above the critical value. This takes us into the region where there is no distinction between liquid and vapor, so that by first reducing the pressure and then lowering the temperature, we pass without any break, to a substance in the truly vaporous state at N, the substance at no time having been in the state of two distinct phases.

To this last clause we take exception on the ground that we started with the substance a liquid at M, and ended with substance as a vapor at N, and therefore there must be a place in the transition where the substance ceases to be a liquid and begins to be a vapor. This follows just as naturally as it follows that when a ball is thrown into the air it reaches a point where it ceases going up and begins coming down.

By hypothesis, A was the critical value, which means that any further increase in temperature or pressure acting either singly or together can not produce any change in the state of the substance, and it also follows that any decrease of pressure or temperature acting either singly or in unison will place the resultant condition in the liquid or vapor region or on OA. If, as in Fig. 2, we draw

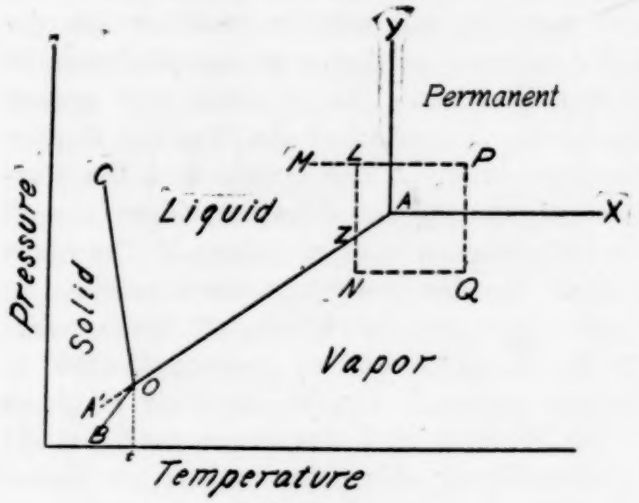


FIG. 2

the limits at which the critical condition can exist, we have YA and AX, because, taking the lowest temperature, that of A, and keeping it constant, and increasing the pressure, we get AY of infinite extent, any value to the left of which, as M, is liquid, and any value to the right, as P, resembles the critical condition at A. Now if we take the minimum pressure, that of A, keep it constant, and increase the temperature, we have AX, any presso-temperature P above AX resembling the substance when at A, while any value below AX, as Q, is vapor.

It is seen, then, that any value within the region YAX is in a special condition, which, for want of a better name, I propose the name "permanent phase."

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CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

BULLETIN OF THE MOUNT WEATHER OBSERVATORY

VOL. I., Part 1, of a new publication, *Bulletin of the Mount Weather Observatory*, has

been issued by the United States Weather Bureau. It bears the names of William J. Humphreys, director, and William R. Blair, assistant director, and is prepared under the direction of the chief of the Weather Bureau (Washington, 1908). In the announcement, signed by the Secretary of Agriculture, it is stated that the *Bulletin*, of which this is the first number, will contain more or less detailed accounts of the researches conducted at Mount Weather. The *Bulletin* will appear quarterly. The chief of the Weather Bureau discusses briefly "The Origin and the Purpose of the Mount Weather Observatory," the last sentence being as follows: "The whole aim of the observatory is the discovery, no matter how nor by whom, of fundamental truths of nature, and of their application to human welfare." Dr. W. R. Blair considers "The Methods and Apparatus used in Obtaining Upper Air Observations at Mount Weather, Va.," which includes the results of the kite flights during June–September, 1907. Professor A. J. Henry concludes with a paper on "The Use of Upper Air Data in Weather Forecasting." The *Bulletin* is illustrated by means of several half-tone views of the kite equipment. There are also diagrams showing the upper air isotherms as determined on different kite flights. This number of the *Bulletin* directs attention, in a striking way, to the work which the Weather Bureau has undertaken at Mount Weather.

EVAPORATION IN THE SALTON SINK

To the *National Geographic Magazine* for January, 1908, Professor F. H. Bigelow contributes some "Studies on the Rate of Evaporation at Reno, Nevada, and in the Salton Sink." Professor Bigelow has been in charge of the Weather Bureau work on evaporation in the southwest, and his preliminary results are full of interest. He states that, although it has been quite generally supposed that as much as eight feet of water will evaporate from the Salton Sea each year, there are now reasons to think that the evaporation may not be more than four or five feet. A temporary experiment station was set up at Reno, Nev., where five towers were built by August 1, 1907, and regular observations were continued until September 15. By that time 100,000 readings of the instruments had been made. It became clear that the reservoir at Reno, which is about 1,000 feet long, covers itself with a sheet of invisible vapor about 30 feet thick, and this vapor acts like a blanket upon fresh evaporation rising from the water. It is proposed to erect two or three towers at the Salton Sea in order to get some idea of the behavior of the vapor sheet lying over that body of water.

TROPICAL TEMPERATURES

The continuation and conclusion of Hann's investigation entitled "Der tägliche Gang der Temperatur in der äusseren Tropenzone" appears in Vol. LXXXI. of the *Denkschr. Wien. Akad. Wiss., math.-naturwiss. Kl.* (1907). The object of this laborious study, so characteristic of the tireless energy and unfailing accuracy which has distinguished all the work of the author, is to obtain, for the tropics, the values needed in order to reduce temperature observations made at different hours to the twenty-four-hour mean. It appears that means based on the daily extremes are quite inaccurate. Hann has, in this second part of his investigation, extended his study to the Indian and Australian tropical region.

FROST IN CALIFORNIA

Professor A. G. McAdie has prepared a short and useful paper entitled "Protection of Fruits and Vegetables in California from Injury by Frost," in which he summarizes the various methods of protection against frost in California, already treated at length in previous publications of the Weather Bureau. The daily weather map for December 21, 1907, is reproduced as illustrating the type pressure conditions upon which frosts are found to occur in California. R. DeC. Ward

BOTANICAL NOTES

FUNGUS NOTES

In a recent number of *Rhodora* (January, 1908) Dr. W. G. Farlow begins the publica-

tion of "Notes on Fungi" which promise to yield critical discussions of much value. He shows that what has been known as *Corticium tremellinum* var. *reticulatum* is, in the first place, not a *Corticium*, but a *Tremella*, and that the variety is a distinct species, to be known hereafter as *Tremella reticulata*. He shows that what has been known as *Synchytrium pluriannulatum* (a parasite in a species of *Sanicula*) is in reality *Urophlyctis pluriannulatus*, and that a uredineous parasite of *Rubus neglectus* and *R. strigosus*, hitherto known as or confused with *Phragmidium gracile*, is *Pucciniastrum arcticum* var. *americanum*. He is further of the opinion that the *Pucciniastrum* on *Potentilla tridentata* is *P. potentillae*. Further notes from this source will be eagerly looked for by mycologists.

In *Annales Mycologici* (V., No. 7, 1907) Professor F. L. Stevens figures and describes "Some Remarkable Nuclear Structures in *Synchytrium*." The paper is a record of facts, and the author does not attempt to base any conclusions upon what he has seen. Other recent fungus papers by the same author are "An Apple-rot due to *Volutella*" and a "List of New York Fungi," in the March and May numbers of the *Journal of Mycology* (1907), and "The Chrysanthemum Ray Blight" in the *Botanical Gazette* (October, 1907). The fungus which causes the ray blight of the chrysanthemum appears to be new, and is described as *Ascochyta chrysanthemi*.

Heinrich Hasselbring's paper on "The Carbon Assimilation of *Penicillium*" in the *Botanical Gazette* for March, 1908, is a contribution to our knowledge of the chemistry of the assimilation of some of the simpler compounds by plants. Among the results noted is the fact that "alcohol, acetic acid and the substances from which the acetic acid radicle CH_3COO—is easily derived are assimilated by *Penicillium glaucum*."

A disease of the sugar cane known as "red-rot" has been investigated by L. Lewton-Brain, pathologist of the experiment station of the Hawaiian Sugar Planters' Association, who has found it to be due to the entrance of the fungus, *Colletotrichum falcatum*, through wounds made by insects or other agents. Once within the tissues of the stem the fungus penetrates the cells, kills them, and gives the affected areas a red color. There is no external sign of the presence of the disease, except in severe cases when the leaves may turn yellow and the whole plant die.

Mention should be made here of Scott and Rorer's paper "Apple Leaf-spot caused by *Sphaeropsis malorum*" in Bulletin 121 of the Bureau of Plant Industry of the United States Department of Agriculture; of W. H. Lawrence's record of "Some Important Plant Diseases of Washington" in Bulletin 83 of the Oregon Experiment Station, and Cook and Horne's "Insects and Diseases of the Orange" in Bulletin 9 of Estación Central Agronómica de Cuba.

Here also may be mentioned Professor Harshberger's paper "A Grass-killing Slime Mould" in the *Proceedings of the American Philosophical Society*, Vol. XLV., recording a case in which the plasmodia of *Physarum cinereum* killed the blades of grass over which they had grown.

NOTES ON ALGAE AND ARCHEGONIATAE

DR. M. A. HOWE continues his interesting Phycological Studies in a recent number of the *Bulletin of the Torrey Botanical Club* (pp. 491–516, 1907) under the title of "Further Notes on *Halimeda* and *Avrainvillea*" accompanying it with six full-page plates. He describes and figures the sporangia of *Halimeda tridens* from Porto Rico, discusses the American species of *Halimeda* of the *H. tuna* group (*H. tuna, H. discoidea* and *H. scabra*), discusses the American species of the *H. tridens* group (*H. tridens, H. monile, H. simulans* and *H. favulosa*), describes the sporangia of *Avrainvillea nigricans*, and enumerates and describes the American species of *Avrainvillea* (*A. nigricans, A. longicaulis, A. levis* and *A. rawsoni*).

Professor Doctor N. Wille's "Algologischen Untersuchungen" (I.–VII.) contains papers on the development of *Prasiola furfuracea;* a

summer form of *Ulothrix consociata;* a new genus of marine *Tetrasporaceae,* which he names *Pseudotetraspora;* on the reproduction of a *Gloeocapsa;* on a species of *Dactylococcus;* on the zoospores of *Gomontia polyrrhiza,* and closes with a list of the Myxophyceae (seven species) and *Chlorophyceae* (twenty-one species) of the neighborhood of the biological station at Drontheim, Norway.

W. D. Hoyt's paper on "Periodicity in the Production of the Sexual Cells in *Dictyota dichotoma*" in the *Botanical Gazette* for June, 1907, deserves mention even at this late date, showing that sexual cells are produced at regular monthly intervals, and have a definite relation to the tides.

Professor Doctor D. H. Campbell's "Studies on Some Javanese *Anthocerotaceae*" in the October *Annals of Botany,* 1907, is the first of two interesting papers. A new genus, *Megaceros,* is described. It has a very large sporophyte (9 cm. high), has no stomata, and contains spiral elaters. The second installment (in the January number) is devoted to the morphology and histology of *Dendroceros* and *Notothylas.* In discussing the affinities of the *Anthocerotaceae* the author regards *Notothylas* as "without doubt the simplest and probably the most primitive," and "the larger species of *Anthoceros,* with their highly developed assimilative tissue and perfect stomata as probably to be considered the highest existing form of this peculiar form of sporophyte." He suggests, moreover, that "it will probably be best to regard *Anthocerotaceae* as sufficiently distinct from the true Hepaticae to form a special class, *Anthocerotes,* as was suggested by Howe" eight years ago.

In a paper in the October (1907) *New Phytologist,* "On the Distribution of the Hepaticae and its Significance," Dr. Campbell adduces good reasons for concluding that "the distribution of the existing liverworts indicates that they are ancient forms whose scarcity in a fossil condition is due to their very perishable tissues."

A third paper by the same author, which appeared in the March (1907) *American Naturalist* and entitled "Studies on the *Ophioglossaceae,*" is a most helpful one for the fern student. The author still adheres to his hypothesis that *Ophioglossaceae* arose from some form resembling *Anthoceros.*

Charles E. Bessey
University of Nebraska

THE NATIONAL CONFERENCE COMMITTEE ON STANDARDS OF COLLEGES AND SECONDARY SCHOOLS

The third annual meeting of this body, which has been known as the National Conference Committee of the Associations of Colleges and Preparatory Schools and is now permanently organized under the above title, was held at the rooms of the Carnegie Foundation for the Advancement of Teaching, 576 Fifth Avenue, New York, N. Y., Friday, April 17, 1908. The committee is composed of delegates from the following organizations, all of which were represented at this meeting:

The New England Association of Colleges and Preparatory Schools,
The New England College Entrance Certificate Board,
The Association of Colleges and Preparatory Schools of the Middle States and Maryland,
The College Entrance Examination Board,
The North Central Association of Colleges and Secondary Schools,
The Association of Colleges and Preparatory Schools of the Southern States,
The National Association of State Universities,
The Carnegie Foundation for the Advancement of Teaching.

A constitution was adopted which defines the purpose of this committee to be to consider standards of admission, matters of common interest to universities, colleges, and secondary schools, and such further questions as may be referred to it. Provision is made that at least one meeting shall be held each year.

Officers to serve for one year were elected as follows: President, President MacLean, of the University of Iowa; Vice-president, Head Master Wilson Farrand, of Newark Academy; and Secretary-Treasurer, Dean Ferry, of Williams College.

A committee of four was appointed to frame a set of units or scale of values for the interpretation of admission requirements and to consider some allied questions. Resolutions were passed advising that work in English and mathematics should be continued through the last school year; recommending that the organizations whose delegates compose the committee be urged to collect data and study the subject of standardizing colleges and universities; and calling the attention of colleges to the fact that lists of accredited schools are now published yearly by the New England College Entrance Certificate Board and the North Central Association of Colleges and Secondary Schools and may be obtained for general reference and use.

FREDERICK C. FERRY,
Secretary-Treasurer

SCIENTIFIC NOTES AND NEWS

THE University of Illinois has celebrated the fortieth anniversary of its founding by a memorial convocation. The address given by Professor C. M. Moss was chiefly a tribute to Dr. T. J. Burrill, vice-president of the university and professor of botany, who has been connected with the institution since its first year.

THE *Boston Medical and Surgical Journal* for May 7 forms a *Festschrift* in honor of Reginald Heber Fitz, M.D., LL.D., Hersey professor of the theory and practise of physic in Harvard University, to celebrate his sixty-fifth birthday, which occurred on May 5.

PROFESSOR C. F. BRACKETT, of Princeton University, who recently retired from the Henry chair of physics, was the guest of honor at a dinner this week, given by the faculty and trustees.

AT a recent meeting of the Toronto Academy of Medicine his portrait was presented to Dr. Reeve, dean of the medical faculty of the University of Toronto, who was president at the meeting of the British Medical Association held in Toronto in 1906.

A PORTRAIT of Dr. John J. M'Kendrick, professor of physiology in the University of Glasgow from 1876 to 1896 and now emeritus professor, was presented to the university on commemoration day held on April 22.

COMMEMORATION DAY at the University of Glasgow was observed on April 22, when Professor Gray, the successor of Lord Kelvin in the chair of natural philosophy, delivered an oration on Kelvin's work. Honorary degrees were conferred, including the doctorate of laws on Colonel David Bruce, C.B., of the Royal Army Medical Corps; James Johnston Dobbie, director of the Royal Scottish Museum, and Robert Kidston, the geologist.

AT the Institution of Electrical Engineers on April 30 Professor Silvanus P. Thompson gave the first Kelvin memorial lecture, his subject being "The Life and Work of Lord Kelvin." Before the lecture Mr. H. F. Parshall presented the institution with a bust of Benjamin Franklin on behalf of the American Institute of Electrical Engineers.

THE Fothergillian medal of the London Medical Society has been presented to Sir Almroth Wright, F.R.S.

Nature states that at the annual general meeting of the Institution of Civil Engineers on April 28, Mr. J. C. Inglis was elected president of the institution. The council has made the following awards for papers read and discussed during the past session: A Telford gold medal to Mr. W. Barclay Parsons (New York); a Watt gold medal to Sir Whately Eliot; George Stephenson gold medals to Sir John Ottley, K.C.I.E., Dr. A. W. Brightmore, and Messrs. J. S. Wilson and W. Gore; Telford premiums to Messrs. F. W. Davis (Darlington), C. R. S. Kirkpatrick (Newcastle-on-Tyne), Hugh T. Ker (Glasgow), G. H. Scott, R. R. Gales (India) and S. H. Ellis.

PROFESSOR H. POINCARÉ, professor of astronomy in the Paris École polytechnique, has retired with the title of honorary professor.

PROFESSOR IRA O. BAKER, for thirty-four years connected with the Department of Civil Engineering of the University of Illinois, has been granted by the trustees leave of absence for one year. Professor Baker will devote

himself to the work of revising his book on "Masonry Construction." The executive duties of the department of civil engineering will, during his absence, be assumed by Professor J. P. Brooks.

Mr. E. P. Taylor, of the Colorado Agricultural Experiment Station, has become entomologist of the Missouri State Fruit Experiment Station at Mountain Grove, Mo.

Mr. H. J. Franklin, who takes his doctor's degree at Amherst in June, has accepted a position with the Minnesota state entomologist at St. Anthony Park, Minn. The U. S. National Museum has recently issued a report "On a Collection of Physanopterous Insects from Barbadoes and St. Vincent Islands" prepared by him. He is also engaged in a work on "Bumble Bees of America" under the same auspices.

The Croonian lecture before the Royal Society was delivered on May 14 by Professor G. Retzius, of Stockholm, on "The Structure of the Central Nervous System of the Higher and Lower Animals."

Dr. R. S. Woodward, president of the Carnegie Institution of Washington, addressed the Phi Beta Kappa of New York on May 18, the subject being "The Carnegie Institution of Washington and its Work."

Dr. Raymond Pearl, biologist of the Maine Experiment Station, lectured before the Portland Society of Natural History on the evening of April 21. The subject of the lecture was "The Improvement of Plants and Animals by Breeding."

Dr. H. F. Osborn, president of the American Museum of Natural History, sailed on May 9 to visit the museums of Paris, Madrid, Brussels and Lyons, lecturing at the last university.

Professor N. M. Fenneman, of the department of geology of the University of Cincinnati, will sail for Naples on May 23. He will there join Professor Davis for the study of physiographic problems in northern Italy and France, and will attend the meeting of the Ninth International Geographical Congress.

Mr. Chester A. Reeds has been engaged by the University of Cincinnati to classify and rearrange the fossil collection and to supplement it by acquisitions from the vicinity of Cincinnati. Mr. Reeds has been acting professor of geology in the University of Oklahoma this year.

Professor Morris B. Crawford, Foss professor of physics at Wesleyan University, will sail for Europe on July 4 to spend the summer in England, France and Switzerland.

Mr. Martin J. Iorns, horticulturist at the Experiment Station, Mayaguez, P. R., has gone to Cuba and Florida to investigate the citrus and pineapple industries.

Mr. L. W. Hawley, expert on wood distillation for the Forest Service, has left Washington for Oregon, Washington, Montana and Idaho, to investigate the possibilities of a future turpentine industry in the northwestern portion of the United States.

Professor August Martin, of Berlin, is visiting this country and will attend the sessions of the American Medical Association and the American Gynecological Society.

The American Museum of Natural History will send out three parties in search of fossil vertebrates this summer as follows: (1) To the Upper Cretaceous of Montana, Mr. Barnum Brown in charge. (2) To the Miocene of northwestern Nebraska, Dr. W. D. Matthew in charge. (3) To the Permian of Texas, Dr. E. C. Case in charge.

A cablegram to the New York *Herald* states that the members of the South Sea expedition organized by the newly established Hamburg Scientific Institute for ethnographical exploration in the Polynesian Islands took leave on May 15 at a special meeting of the institute. The expedition will start from Hong Kong on the Hamburg-American line steamship *Peiho*, specially chartered for that purpose for two years. Its leader, Professor Fuelleborn, is well known as an explorer of East Africa, and is assistant at the Hamburg Institute for Tropical Diseases.

Professor Gilbert M. Gowell, who recently severed his connection with the University of Maine after twenty-five years' service, during which his work had been largely concerned with experiments on poultry, killed

himself on May 6, at the age of sixty-three years.

DR. PIERRE JACQUES ANTOINE BÉCHAMP, formerly professor at Montpellier and Lille, eminent for his researches in organic chemistry, died on April 15, at the age of ninety-two years.

THE deaths are also announced of M. C. E. Chamberland, the sub-director of the Pasteur Institute, Paris, at the age of fifty-seven, and of M. Alfred Riche, professor of mineral chemistry at the Sorbonne from 1874 to 1899, at the age of seventy-eight.

THE American Nature-study Society will hold a conference on the Training of Teachers of Nature-study at Cleveland, Ohio, on the afternoon of July 3. This conference may be regarded as preliminary to a more extensive consideration of the same topic at Baltimore next December.

THE German Association of Men of Science and Physicians will hold its annual meeting this year at Cologne from September 20 to 26.

THE Eighth International Congress of hydrology, climatology, geology and physical therapy will be held from April 4 to 10, 1909, in Algiers.

THE Chemical Society of Rome, the Chemical Society of Milan, and the Association of Industrial Chemists of Turin will unite to form the Italian Chemical Society.

A SCIENTIFIC society has been formed in Mexico with the title "La Alianza Cientifica Universal." It is described as a ramification of a general confraternity of scientific men which was founded in Paris by M. Leon de Rosny and is intended to include the scientific men of Europe and Latin America. The active president of the Mexican society is Professor Alfonso Herrera, while the president of the republic is honorary president and all the members of his cabinet are honorary members of the Alianza. The list of active members in the federal district consists of professors and professional men—scientific and technical—and government officials.

ACCORDING to the *Journal of the American Medical Association* the annual congress of the Russian Pirogoff Medical Association, the national organization, can not be held this year, as the authorities have refused the usual permit. The February number of the journal issued by the organization was confiscated recently on account of an article by Dr. W. Kanel which failed to pass the censor on account of its alleged revolutionary tendency. The editor of the journal, Dr. J. W. Popoff, is also held legally responsible for permitting the publication of the article.

AT the recent meeting of the National Academy of Sciences held in Washington the following resolution was adopted:

Resolved, That four members of the academy be appointed by the president as a committee on paleontological correlation, including two specialists in invertebrate and vertebrate paleontology, respectively. The present committee shall serve two years only and be eligible to reappointment or substitution of new members in 1910. The committee shall have power to extend its membership so as to secure American and international cooperation.

In compliance with the resolution, the president appointed Messrs. H. F. Osborn and William B. Scott in the field of vertebrate paleontology and Messrs. C. D. Walcott and William H. Dall in the field of invertebrate paleontology.

ON the recommendation of Professor David Todd, of Amherst College, who visited South America and the Isthmus last year, eastern standard time has been adopted at Panama, per order No. 167 of the chairman of the Isthmian Canal Commission. The change went into effect on April 27, the newly adopted standard time being 54 minutes faster than Panama railroad time previously kept, and 18 minutes faster than the local astronomical time at Panama. All departments and divisions of the Isthmian Canal Commission have since that date observed the new standard time. The proposition to adopt the same standard is now before the Ecuadorian government, and Professor Todd has recently received word that the National Geographical Society of Lima has recommended to the

Peruvian government the adoption of eastern standard, or 75th meridian, time for the whole of Peru.

Eight new drainage districts have been organized in the southeastern part of Wisconsin by the soils department of the state university experiment station. This is a particularly favorable season for this reclamation work, since, owing to the dry weather of last fall, the marshes of the central and southern part of the state are much drier than usual. Professor A. R. Whitson, of the university soils department, has recently investigated three of these districts and found that they can be reclaimed successfully and profitably by drainage. The largest of these—the Norway and Dover district in Racine County—is a tract of 17,000 acres of shallow muck underlaid with clay. This land, which is now of little value, as only wild grass can be cut on it once in two or three years, will unquestionably show a high degree of fertility after drainage, when hay, corn and other farm crops will be grown.

The *Yale Alumni Weekly* states that the increased use of the Peabody Museum, owing to the recent Sunday opening, and the cramped space for exhibiting the large specimens and the increasingly large collections have directed attention to the plan for future enlargement. A design for the completed building, drawn by the architect of the wing already erected, J. Cleveland Cady, of New York City, was approved by the late Professor O. C. Marsh, and the drawing now hangs on the walls of one of the office rooms on the second floor of the museum. It represents a large central hall with a wing exactly like the present structure extending down to Library Street. The cost of the central hall alone is estimated at about $300,000, and the accumulated building fund for the purpose is reported at about $150,000. The architect recently communicated with Treasurer McClung with reference to submitting revised plans for the completed museum to meet present needs. Nothing definite has been done in regard to the plans and it is possible that when an adequate museum is erected it may be on the university's new property to the north of the present campuses.

One of the most important economic movements of the day about which the general public has yet learned little is the concerted action of owners of timber in different parts of the country in organizing associations to protect their holdings from fire. In the Pacific northwest, the Washington Forest Fire Association has just elected officers at Seattle and begun work for the year with 3,000,000 acres under its care. The plans include a system of patrol by rangers resembling the work done by the United States Forest Service in guarding against and extinguishing fires. Organizations of similar kind and for a like purpose are at work in Oregon and Idaho. In the latter state, a portion of the expense is borne by taxation and paid from the state treasury. A western railroad company which holds large tracts of timber has taken steps to guard its property from fire, and during the short time that its plans have been in operation, it has met with most encouraging success. Similar work is being done on the other side of the continent. Forest owners in Maine have gone to work in the same systematic way to control the forests' great enemy, fire. Like organizations are found in other parts of the country, showing how fully it is now realized that protection against fire is of the greatest importance. It is safe to say that fires in this country have destroyed more timber than lumbermen have cut. When timber was abundant, the waste passed almost unnoticed, but now that a scarcity is at hand and an actual wood famine threatens in the near future, the owners of forest lands are waking up and taking action to save what is left.

The lectureship on physic founded at St. John's College, Cambridge, by Thomas Linacre in 1515 has hitherto been held for a term of years. It is now, as we learn from *The British Medical Journal,* converted into an annual office, and every year some person of eminence will be asked to deliver one public lecture in the Easter term. This ancient lectureship has been held in the past by many distinguished men; among them were William Barondale, Thomas Gisborne and Sir Thomas Watson, all presidents of the Royal College of

Physicians of London, and by Sir Isaac Pennington, John Haviland and Sir George Paget, who were Regius professors of physic in the university. William Heberden was also a Linacre lecturer, so were Henry Paman and Henry Briggs, who were also Gresham professors. The last named was the inventor of the decimal system of logarithms, and was not a medical man. Perhaps the most distinguished members of the laity who have held the lectureship were Matthew Prior, the poet and diplomatist, and Edward Stillingfleet, Bishop of Worcester. From 1894 until his appointment to be principal of Glasgow University the lectureship was held by Dr. Donald MacAlister. The first lecture under the new scheme was given on May 6, by Dr. Osler, regius professor of medicine in the University of Oxford, who took for his subject Thomas Linacre, his life and work.

THE total cost of the buildings erected in the principal cities of the United States in 1907 was $661,076,286, according to Mr. Jefferson Middleton, of the U. S. Geological Survey, who has collected statistics on this subject in connection with his work on the clay-working industries. Compared with the cost of buildings in the same cities in 1906, these figures show a net decrease of $17,634,683, or 2.60 per cent.; they are, however, 2.55 per cent. in excess of the figures for 1905 and 40.86 per cent. greater than in 1904. Although the total cost of buildings in the 49 cities reporting was decreased, the number of permits increased from 181,174 in 1906 to 184,055 in 1907. In some cities more than one building was erected under one permit, but as a rule a permit was issued for each building. The city showing the greatest decrease in cost of buildings is New York, the value of whose operations fell off $41,591,982, or 26.84 per cent. St. Louis showed the next largest decrease—$8,045,526, or 26.87 per cent.; next is Chicago, which reported a falling off of $5,616,245, or 8.68 per cent. Philadelphia, Boston and Brooklyn also showed decreases in 1907, though Brooklyn nearly held its own, the decrease being only $149,304, or 0.21 per cent., a better showing than that of any other of the very large cities in which normal conditions prevailed. In Baltimore, where large gains had been reported in 1904 and 1905 as the result of the fire in 1904, the cost of building operations also decreased, though it was more than twice as great in 1907 as in 1903, when the cost was but $3,327,225. It is probable that most of the decreases were due to the financial disturbance during the latter part of the year, although the decrease in Los Angeles, which has shown remarkable increases in past years, appears to have been due rather to scarcity and high cost of material than to the business depression. Twenty-five cities reported an increase in cost of building operations. In San Francisco, owing to the local conditions following the fire, the increase was $56,574,844, the total amount being nearly 162 per cent. in excess of the cost for 1906. The total number of permits issued in 1907 for buildings in San Francisco was 12,126, and the cost of the buildings was $91,502,240. In 1905, the year prior to the fire, its building operations cost $18,268,753. In Cambridge, Mass., which, with the exception of San Francisco, showed the largest proportionate gain, the erection of several large mercantile buildings swelled the total. Cleveland's building industries seem not to have been affected by the financial depression, showing an increase of $2,915,433, or 22.47 per cent., over the figures for 1906. The reports for Milwaukee show an increase of more than a million dollars, due to the increase in the number of fireproof or fire-resisting buildings erected.

UNIVERSITY AND EDUCATIONAL NEWS

A RESEARCH laboratory of applied chemistry will be established shortly at the Massachusetts Institute of Technology, with Professor W. A. Walker in charge.

THE Hong Kong correspondent of the *British Medical Journal* writes that the governor, Sir Frederick Lugard, convened a meeting on March 18, to consider the possibility of establishing a university in Hong Kong. He announced that Mr. Mody, a Parsee, had placed £15,000 at his disposal for that purpose. The governor was willing to recommend the gov-

ernment to provide a site, and personally was anxious to see the project take shape. He believed that a university at Hong Kong would attract a large number of the wealthy Chinese students who now went to Japan, America and Europe, and would increase the prestige and influence of Great Britain throughout the Chinese empire. To provide an adequate endowment for even the modest beginning proposed, a sum of about £100,000 would be required.

Representatives of the faculties of ten New England colleges met in Providence on May 6 to discuss problems of university administration. The institutions represented are Amherst, Bowdoin, Dartmouth, Harvard, Tufts, Maine, Wesleyan, Williams, Yale and Brown, and the delegates in most cases were the deans.

The George Washington University has established a separate department of psychology, with Williston S. Hough, Ph.M., Shepherd Ivory Franz, Ph.D., and William Carl Ruediger, Ph.D., as teaching staff. There are to be two psychological laboratories, one for elementary class instruction and experiments bearing on educational problems, and one for the advanced research work of graduate students.

Several changes will occur in the science departments at Wesleyan University next year. In the biological department, Mr. David Day Whitney, A.B. (Wesleyan 1904) and candidate for Ph.D. (Columbia) this June, will succeed Mr. Budington as instructor in biology. Two new courses will be added in connection with the laboratory courses now offered in general biological laboratory work, one a course in histology for prospective students of medicine, the other an extensive botany course, designed for those intending either to study forestry or to teach botany. The chemical department will be considerably enlarged and improved, while courses in physical chemistry and electro-chemistry will be introduced. J. W. Turrentine, a graduate of the University of North Carolina (1902), and candidate for Ph.D. at Cornell, where he has been pursuing graduate study for three years, will be instructor in chemistry, to fill the place of Mr. Hale, who intends to study for his degree in Cornell.

At the University of Wisconsin H. A. Parker has been appointed instructor in topographical engineering. The regents also made a number of promotions in the faculty. A. N. Winchell, now assistant professor, becomes professor of mineralogy and petrology, and Associate Professor M. C. Beebe has been appointed professor of electrical engineering. H. J. Thorkelson has been made associate professor in the department of steam engineering. Instructors who have been appointed to assistant professorships are: L. R. Ingersoll, physics; J. G. Fuller, animal husbandry; W. L. Koelker, chemistry; W. G. Marquette, botany; B. M. Allen, anatomy; A. V. Millar, mechanical drawing; R. MacA. Keown, machine design; J. W. Watson, electrical engineering; O. P. Watts, chemical engineering. Chauncey Juday was made lecturer in zoology. New instructors are as follows: J. H. Matthews, physical chemistry; W. E. Grove, pharmacology; W. H. Brown, pathology; Walter J. Meek, physiology; R. C. Disque, electrical engineering. R. T. Craigo has been appointed instructor in mathematics in the university extension division. Assistants who are promoted to instructorships are: F. K. Brainard, physics; W. J. Mead, geology; P. Skadky, mechanical practise, and E. E. Parker, applied engineering. The new assistants include: A. R. Koch, pharmacy; M. C. Otto, philosophy; F. W. Williams, geology; L. F. Ausburger, analytical chemistry; David Klein, chemistry; H. L. Walster, soils, and R. L. Marshall, soils.

Dr. S. O. Mast, Johnston research scholar at Johns Hopkins University and professor of biological science at Hope College, has been appointed associate professor of biology at the Woman's College of Baltimore.

Victor E. Emil, Ph.D., Austin teaching fellow in histology and embryology in the Harvard Medical School has been appointed instructor in biology at the George Washington University.

Mr. Chas. T. Vorhies, of the University of Wisconsin, has been elected to the chair of biology in the University of Utah.